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Summary

This Deliverable D8.3 "Final evaluation" contains the experiences acquired from conducting multi-disciplinary evaluation of the PICOS products and results, as documented in D8.1 and D8.2. It also presents general recommendations for the future implementations of privacy- and trust-enhancing identity management systems on a European scale. This deliverable also summarises the feedback and results of a comprehensive questionnaire which was compiled for the recreational anglers as the first PICOS leisure time community. This exercise has been an important step to substantiate findings and assumptions related to gathering community requirements with respect to the PICOS concepts.

The PICOS project receives research funding from the Community's Seventh Framework Programme.

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The PICOS Deliverable Series

D2.1 Taxonomy	July 2008
D2.2 Categorisation of Communities	July 2008
D2.3 Contextual Framework	November 2008
D2.4 Requirements	November 2008
D3.1.2 Trust and Privacy Assurance for the Design Platform v2	January 2011
D3.2.2 Trust and Privacy Assurance for the Platform Prototype v2	January 2011
D3.3.2 Trust and Privacy Assurance for the Community Prototype v2	January 2011
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D4.1 Platform Architecture and Design v1	March 2009
D4.2 Platform Architecture and Design v2	September 2010
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D6.1 Community Application Prototype 1	December 2010
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D8.1 Legal, economic and technical evaluation of the first platform and community prototype	April 2010
D8.2 Legal, economic and technical evaluation of the second platform and community prototype	February 2011
D9.1 Web Presence	February 2008
D9.2.1 Exploitation Planning	May 2009
D9.2.2 Exploitation Plan 2	March 2010
D9.3.1 Dissemination Planning	May 2009
D9.3.2 Dissemination Report V2	March 2010

These documents are all available from the project website http://picos-project.eu.

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The PICOS Deliverable Series

Vision and Objectives of PICOS

With the emergence of services for professional and private online collaboration via the Internet, many European citizens spend work and leisure time in online communities. Users often consciously leave private information online, but they may also be unaware of leaving such information. The objective of the project is to advance state-of-the-art technologies that provide privacy-enhanced identity and trust management features within complex community-supporting services that are, in turn, built on Next Generation Networks and delivered by multiple communication service providers. The approach taken by the project is to research, develop, build, trial and evaluate an open, privacy-respecting, trust-enabling platform that supports the provision of community services by mobile communication service providers.

The following PICOS materials are available from the project website http://www.picos-project.eu.

PICOS documentation

- Slide presentations, press releases, and further public documents that outline the project objectives, approach, and expected results.
- The PICOS global work plan, which provides an excerpt of the contract with the European Commission.

Planned PICOS results

- *PICOS Foundation* is for the technical work in PICOS, and is built on the categorization of communities, a common taxonomy, requirements, and a contextual framework for PICOS platform research and development;
- *PICOS Platform Architecture and Design* provides the basis of the PICOS identity management platform;
- *PICOS Platform Prototype* demonstrates the provision of state-of-the-art privacy and trust technology to the leisure and business communities;
- *Community Application Prototype* is built and used to validate the concepts of the platform architecture and design, and their acceptability, in private and professional community scenarios;
- *PICOS Trials* validate the acceptability of the PICOS concepts and approach chosen, from the end-user point of view;
- *PICOS Evaluations* assess the prototypes from a technical, legal and social-economic perspective, and result in conclusions and policy recommendations;
- *PICOS-related scientific publications* are produced within the scope of the project.

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Foreword

PICOS partners from various disciplines have contributed as authors to this document. The following list names the main contributors for the chapters of this document:

Chapter	*Contributor(s)*
1. Introduction	Eleni Kosta (ICRI – K.U.Leuven)
2 Assurance results and recommendations on trust and privacy	José-Luis Vivas, Isaac Agudo (UMA), Marek Kumpošt (MU)
3.1 Technical results and recommendations: Community focus	Karsten Radatz, Stefan Eicker (ITO)
3.2 Technical results and recommendations: Location data	Georg Kramer (DTAG)
4 Usability results and recommendations	Susen Döbelt, Johann Schrammel (CURE)
5. Gathering angling community requirements: from questionnaires results to functional PICOS features	Bernd Ueberschär (IFM-GEOMAR)
6 Economic results and recommendations	Stephan Heim (GUF)
7 Legal results and recommendations	Eleni Kosta (ICRI-K.U.Leuven)

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List of acronyms

API	*Application Programming Interface*
C2C	*Consumer to Consumer*
B2C	*Business to Consumer*
ID	*Identity*
ISTPA	*International Security, Trust & Privacy Alliance*
LBS	*Location Based Service*
NLB	*Network Load Balancing*
PA	*Privacy Advisor*
PET	*Privacy Enhancing Technology*
POI	*Point of Interest*
RPC	*Remote Procedure Call*
UML	*Unified Modelling Language*
WP	*Workpackage*
WSDL	*Web Services Description Language*

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1 Introduction

The evaluation work that was conducted in D8.1 "Legal, economic and technical evaluation of the first platform and community prototype" and D8.2 "Legal, economic and technical evaluation of the second platform and community prototype", was undertaken from an assurance, technical, usability, economic and legal point of view, allowing for a holistic evaluation of the PICOS design and architecture, the PICOS platform prototype and the PICOS application prototypes. This Deliverable D8.3 "Final evaluation" contains the experiences acquired from conducting multi-disciplinary evaluation of the PICOS products and results. It also presents general recommendations for the future implementations of privacy- and trust-enhancing identity management systems on a European scale. The deliverable is also complemented by the presentation of the feedback and results of a comprehensive questionnaire which was compiled for the recreational anglers as the first PICOS leisure time community. This exercise has been an important step to substantiate findings and assumptions related to gathering community requirements with respect to the PICOS concepts. The intent of the questionnaire was to address more specific and functional PICOS requirements related to privacy and trust issues that would lead to concrete PICOS features and components. A detailed analysis of the results of this questionnaire is being presented in Annex I of this deliverable, illustrating the significance of the questionnaire results, as well as substantial findings for the final design and development of the PICOS platform and the related mobile application (AnglersBase) which were in the first version specifically designed for the needs of the angling community.

2 Assurance results and recommendations on trust & privacy

This section is organized into two main subsections. In the first one, results concerning privacy and trust related research in both cycles of the PICOS project are put forward. In the second subsection, the focus is on assurance itself, and an assessment of the assurance process in PICOS is presented.

2.1 Privacy and trust related research

This section provides results of privacy and trust related research carried out in the two development cycles of the PICOS project. Information provided in this section is based on the experiences from the PICOS project and on the PICOS Architecture, Platform Prototypes, Community application documentation, as well as on the evaluation of both PICOS prototypes.

2.1.1 PICOS Privacy Principles

A set of the PICOS Privacy Principles[1] is one fraction of the complete set of PICOS Principles (PPs) that guided the whole PICOS Architecture. Privacy principles, as well as other PICOS Principles, were derived from the results of information/requirements gathering from real-world and potential online community members – more specifically from the community of anglers and the online gaming community. The design of principles was also influenced by our experience in the fields of communication, security and social values in trust and privacy.

Openness and transparency – PP5

[1] PICOS D4.2 "Platform Architecture and Design v2", Appendix C.

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The PICOS Architecture must offer services to Members in an open and transparent way.

The aim of this principle is to increase users' trust in the Architecture. If the system is transparent and open, then everybody can see how information is processed and secured against misuse. It is also necessary to provide information about the system and its processes in a very understandable way.

Trust between communities – PP6

The PICOS Architecture must recognize trust as a common currency when exchanged between PICOS Communities.

The goal of this principle is to allow users to "transfer" trust or reputation from one Community to another. It is quite normal that current social networking systems allow users to have different memberships. If a user is trustworthy in one Community, it should be possible to positively influence (at least the starting level of) his/her trust or reputation in another Community.

Data minimisation – PP8

The PICOS Architecture must support the concept of data minimisation. Only data absolutely necessary for the provision of the Service should be collected.

According to the data minimisation principle, Members are required to provide only the necessary information for getting access to the Service. This is a natural privacy-related principle and can also help to build Members' trust in such systems. As Members' trust in the system grows, they may become willing to provide further personal information that is shared within their Community. As a general recommendation for any identity management system – it should be possible to become a member by providing only the minimal amount of required (initial) information about new users.

End-to-end privacy – PP9

The PICOS Architecture must support end-to-end privacy.

End-to-end privacy, as it is applied in PICOS, is a way of protecting private information within the PICOS Architecture. This is done by applying specific legal obligations on Community operators, who have technical ways to access private information stored on internal devices. Application of legal obligations and statements about the real recourses should be definitely seen as a way of increasing trust in a system as a whole.

Provenance – PP12

The PICOS Architecture must ensure that Members can rely on the provenance of information that they receive from other Members/PICOS Communities, subject to the Member choosing to state the provenance and there being no conflict or risk of undermining other privacy principles.

The goal of this property is to increase Members' trust in information received from other Members or PICOS Communities. As it is difficult to guarantee the accuracy of information, this property may provide information about the level of trust (based on reliability of the source, or reputation score). If users can get the information about the source of any content, they can use other ways of communication to check the reliability of the source and use such context information as well.

External services – PP13

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The PICOS Architecture must ensure that externally hosted services are delivered in as trustworthy a way as an internally hosted Service, or that Members are aware when an external service is (potentially) less trustworthy than an internal service.

Any service that is provided by an external subject can possibly pose a risk of data abuse/misuse. Since the externally provided service is not under any kind of operation of Community operators, the only way is to explicitly inform Members, that the service they want to use is provided externally (with the explicit description of all possible risks of data abuse).

Audit – PP14

The PICOS Architecture must allow all services to be fully auditable by an entity trusted by all Members.

Sufficient and reliable auditing of services must be applied and enforced in order to support Members' trust in the system as a whole. This should also help for being able to prevent and recover from privacy intrusive events. Audit should be done transparently and by an entity who is trusted by Members. Results of the audit should be available to Members.

Subjective and objective trust – PP16

The PICOS Architecture should support both objective and subjective methods for assessing trust.

Subjective trust is assessed by Members based on their experience and, e.g., reputation score of other Members. Objective trust is based on objective methods like trusted computing base and reputation management system. Regarding the reputation management system – it should be always very clear how the reputation score is calculated and what information it is based on.

Authentication – PP17

The PICOS Architecture should support multiple forms of Member authentication, while continuing to respect privacy.

Authentication is necessary in order to protect Members identities. It should be always clear which authentication method(s) is used and the users should be informed about possible threats.

Multiple persona – PP18

The PICOS Architecture should allow Members to have multiple persona.

The principle of multiple personae means that Members can define and use different identities. This principle helps to protect Member's real identity and to limit the linkability between user identifiers and performed actions. Members should be informed about this possibility in a system in order to use it properly.

Sub-groups – PP19

The PICOS Architecture must support the creation of sub-groups within the Community.

Existence of sub-groups or any other kind of sub-communities within one Community is natural and can contribute to the protection of private information shared within such sub-group(s).

Trust – PP23

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The PICOS Architecture should ensure that Members are accountable for their actions while a member of the Community.

This principle should work together with Audit in order to acquire information about all activities within the system, communities and sub-communities. It should be clearly stated how the gathered information will be protected and who has access to it.

2.1.2 Other privacy and trust related issues

This section discusses the most important trust and privacy related aspects of PICOS Platform and PICOS Application prototype. This includes Platform components and Privacy rules "editor" in Application prototype. These are the remaining trust and privacy related issues besides those included in the PICOS Architecture which were discussed in previous section (2.1.1).

2.1.2.1 Platform components related to trust and privacy

Below is a brief summary of how trust and privacy related components of the PICOS platform were implemented.

Privacy Advisor (PA)

Privacy Advisor (PA) is special assistant/component within the PICOS platform, the goal of which is to inform Members if their actions should lead to non obvious possible consequences with regard to trust and privacy. The PA observes personal (sensitive) information in content which is going to be published and provides advices (typically via notifications) in three different scenarios:

- Content awareness – content is examined each time a member contributes to a forum, a public or private sub-community or to a repository.
- Sub-community dynamics awareness – PA of a creator of a sub-community "monitors" the reputation of other members of that sub-community and notifies the creator.
- Workflow awareness – when a member chooses to delete an identity or to leave the community, he decides what happens with the data that the community retains.

Privacy Advisor should be considered as a crucial element of privacy protection, since it actively informs users about their actions and possible risks.

Private Room server

This component offers Members the functionality of having their own place for storing personal content. This place is accessible only by its owner. Content from this place can be copied to a sub-community repository or to a public community in order to share it with other Members.

Policy server

This component is responsible for storing rules attached to various objects or attributes of objects and for evaluating user action based on the set of rules. Other components are responsible for asking the policy manager to evaluate actions on resources (for example user attributes or community resources). Users can create various privacy policies on their attributes by specifying who has access to this information. The platform stores these policy rules and enforces them when a user decides to perform action on a particular resource. Overall, the policy server allows creating highly detailed privacy policies but this functionality must be delivered to the end users in a way that they will get to know

how it works and what it is good for. The policy server in the second phase of the PICOS project (Online gaming community) allows a finer control about who, when and how can access shared information. This is very important for users of the Platform, as it supports the trustworthiness of it. Privacy aware users may want to know who has access to their shared information and how they can control access policies. Further details of this update are discussed in document D8.2.

Reputation server

Users contributions in a forum or in the public repository, on both community and sub-community level, can be rated by either the members of the public communities for public contributions or by the members of sub-communities for sub-community contributions. These ratings have a direct impact on the reputation of a user. The reputation component also stores additional user related information, such as the number of contributions, as well as the number or ratings.

Public community server

This component is responsible for Category object, Forum object, Member object and related attributes. This component provides access to the forums and public repository and the possibility to create forums and forum threads. For both the forums and the public repository, the client application can decide to allow association of privacy rules to each piece of content they publish via the policy manager. Privacy rules can apply to the whole content or to sensitive attributes of the content (publisher information, location information, etc.).

Partial identity server

This component is responsible for managing identities of the user/Member. Besides the primary identity created during the registration process, users can create additional identities, called partial identities. The primary goal of partial identities is to keep anonymity of users. A Member can use either the primary identity or partial identities to use the platform services. Users can also redefine some attributes of their primary identity under their partial identity. Primary identity is managed by Profile Server – a component that is in charge of managing profiles attached to identities (rootId or partialId). The profile server enforces policies defined in the policy server with regard to the attributes in a profile

2.1.2.2 Community application prototype

The Community Prototype provides a mobile interface for the platform services to the end users. Its functionality is largely based on the functionality provided by the platform, on which it depends. As a result, if the Platform Prototype does not support a given functionally or enforce a given principle, it is hard or impossible for the Community Prototype to do it. In this sense, the underlying functionalities of the Community Prototype related to *Public Community, Policies, Partial identities, Private Rooms, Profiles, Privacy Advisor, Presence, Reputation,* and *Location,* do not differ from the functionalities provided by the Platform Prototype.

The main task of the Community Prototype is to present to the end user an interface to the functionality provided by the platform that respects the established trust and privacy principles.

Privacy Rules

The privacy rules can be managed (in one place within the Community application prototype) by the users themselves with the aid of the policy manager. The latter provides a very intuitive interface for

the creation of privacy rules that control access to the data associated to the members of the community.

In particular, both presence information and location data can be protected, using the same privacy rules associated with the profiles, by using the Policy Manager or the Policy Creator. The parameters for defining the privacy rules are:

- "*Scope of the Privacy Rule"*, where the user has to select one or more partial IDs that will be the owner of the rule.
- "*Type of the Privacy Rule"*, where the user can select the type of the rule to either Presence, Location, or Profile.
- "*Privacy Rule affects…"*, where the user selects which members (in fact only partial identities can be selected) will be affected by the rule.
- "*Privacy rule for"* section, where the user finally selects which resource will be open for public view; the user may select "*Yes*" or "*Not*" in order to allow the affected partial identities to see the resource, or "*Ask Once*" and "*Ask Always*" if the user wants to be prompted before allowing someone else to see the resource.

2.2 Assessment of assurance

In this section we turn to an assessment of the PICOS assurance work itself. In the first subsection we discuss the goals and the results of the assurance process in PICOS. Next, a subsection is dedicated to a discussion of the assurance planning, execution, and organizational structure of PICOS. Finally, some recommendations for future PICOS development concerning issues that are important for trust and privacy are put forward.

2.2.1 Goals and results of assurance in PICOS

The aim of assurance is to establish a basis for outsiders to gain justifiable confidence that the final product is endowed with a set of desired properties, including privacy and security. Security assurance should thus objectively demonstrate, and not only attest, that the system satisfies a determined set of security properties. It is therefore important to stress here the fact that assurance, as we view it, is not evaluation of the final product, and neither a verification or validation of certain properties. Instead, verification and validation results should themselves be viewed as input to the assurance process, as raw material for the construction of the assurance case.

The results of an evaluation would be an assessment of how well the final product satisfies the initial set of requirements. The value of the final judgment for outsiders would depend on how authoritative the evaluators are considered. By contrast, the aim of building an assurance case is to eliminate this subjective factor. The task of assurance is not to give a subjective evaluation of the final product, but instead to let outsiders themselves evaluate the trustworthiness of the final product based on produced objective facts and evidence. Outsiders themselves are enabled to make their own assessment of the final product. As such, an assurance case does not judge the product. The lack of evidence about a feature of the system does not mean that this feature is absent, only that no objective and verifiable evidence about this feature is available. Hence, no final conclusions from the assurance team about the final product can be derived, only the fabrication of an assurance case allowing outsiders to assess the final product with regard to a determined set of requirements and based on the objectively verifiable evidence provided.

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Being a research project, the main objective of PICOS was not to produce a final commercial product with extensive documentation, but rather to advance the state of the art in the area of privacy and identity management for online services. On the other hand, PICOS assurance itself should also be viewed as a research endeavour. The aim of PICOS assurance work would be not only to produce an assurance case for the PICOS Platform and Community Prototypes, but to advance the research in the area of assurance.

These facts set some limitations with regard to the creation of an assurance case. On the one hand, one cannot expect the same level of documentation that the development of a product for commercial purposes would require in order to provide a complete assurance case. This means that in PICOS one should not simply create a complete assurance case based on previous standards and best practices, but should elaborate an innovative assurance process and validate it with whatever results of the PICOS project offered. This was accomplished with the advancement of a novel methodology based on the notion of assurance case and explained in a paper entitled "A methodology for security assurance-driven system development"[2]. In this paper, the PICOS assurance methodology was presented. The methodology was intended to integrate assurance case creation with system development. The leading force behind the approach was the ambition to develop a methodology for building and maintaining security cases throughout the system development life cycle in a typical system engineering effort, since it is at this stage of development that much of the information relevant for assurance is produced and feedback can be provided to system developers.

It is important to note finally that no standards concerning assurance case has been adopted so far, although it has been under discussion during the time PICOS has evolved. We were thus forced to adopt an own version of an assurance case, which could be of help in the elaboration of a future standard. An assurance case shows how a top level claim is supported by lower-level claims, which recursively are shown to be supported by other claims.

The gist of our methodology is to create a hierarchy of goals encompassing different levels of abstraction and different phases of system development, thus facilitating linking and tracing. In this way, assurance links are established between assurance arguments and development artefacts at each phase of development. In this way, the assurance case allows outsiders and non-experts to judge themselves, without the need to fall back upon the judgment of experts, whether the high-level security objectives have been satisfied. It offers a reviewable, repeatable, maintainable, and improvable process allowing outsiders to determine whether and how high-level security objectives have been satisfied. Finally, it offers also a way of determining the impact of changes in the system or its components on the high-level security requirements and goals.

2.2.2 PICOS assurance planning, execution and organisational structure

The software assurance effort in PICOS integrated assurance aspects early in the project, i.e. during the project concept and initiation phase. The assurance activities were properly phased, with the design phase preceding the implementation phase and prototype construction in a two-cycle approach. The holistic approach adopted was very beneficial for the assurance work, and bringing assurance aspects early in the project has clearly helped in eliminating many risks and threats already at the design phase.

The types and amount of the planned assurance activities in PICOS have proven to be adequate. However, the formality of the assurance activities planned were a bit too high, since the

[2] JOSÉ LUIS VIVAS, ISAAC AGUDO, JAVIER LOPEZ: *A methodology for security assurance-driven system development*. Requir. Eng. 16(1): 55-73 (2011).

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documentation produced by the other work packages was less formal than expected at the beginning of the project. This also forced the assurance team to adopt another strategy than initially planned, with a much less formal assurance analysis than previously sketched.

Assurance planning should be tailored to reflect the assurance needs of a project. In PICOS, this concerns the privacy and trust requirements of the project. We believe that the amount of work dedicated to PICOS assurance reflects fairly well the criticality of privacy and trust within PICOS and the size of the produced software.

Assurance functions in PICOS was led by an entity within the project which was separated from the entities performing engineering activities, an approach which experience has shown to be the most adequate one. Experience has shown that assurance should be organisationally separated from the engineering teams, which has been the case in PICOS, although contributions from several partners were also provided.

It is generally accepted that in large software producing organisations the software assurance team should report to top management, since this is a way to guarantee that standards and procedures are followed. If the assurance team is not independent, impartial assessment would be difficult. In PICOS, these guidelines were followed. However, assurance work was carried out in the form of proactive measures from the assurance team. We believe that this approach has some limitations, since assurance may be thus seen as an add-on to the project rather than an integral part of it. In the case of PICOS, three work packages were directly involved with assurance, namely WPs 4, 5, and 6. Only once was assurance mentioned in the description of work for these work packages, in Task 4.1 of WP 4. On the other hand, assurance was not mentioned at all in the descriptions of WPs 5, 6. Assurance was thus not very well integrated in the work plans of these work packages. Proactive measures from the assurance team helped in minimising this problem. However, we believe that, in general, assurance must be embedded more clearly in the description of work of each involved work package, minimising the need of external proactive measures, and that required proactive measures are more effective if carried out by the project coordinators directly. Future projects involving assurance as an integral part of it should consider these issues carefully.

After considering several possibilities, among others the use of Common Criteria, an assurance program based on the notion of assurance case was established at an early phase of the project development. This initial plan was carried out with some modifications due to the amount of documentation provided, the way the project evolved and new documents and research results that appeared during the development of PICOS. The area of online communities, as well as assurance itself, are under constant development, and the assurance team has made an effort to incorporate the most important new findings, standards and recommendations in the assurance work. For instance, an evaluation of the PICOS architecture design, platform and prototypes was performed based on the threats and recommendations put forward in several reports published by ENISA (European Network and Information Security Agency).

One important decision made by the assurance team was the selection of a set of privacy principles related to the legislation that PICOS should satisfy, since one of the most important requirements established for PICOS was that PICOS should comply with all relevant legislation, specially the EU Data Protection Directive. Since to our knowledge no authoritative source was available at the time, we decide to use the classification given in the ISTPA Analysis of Privacy Principles[3], in which 11

[3] ISTPA (INTERNATIONAL SECURITY TRUST AND PRIVACY ASSOCIATION), Analysis of Privacy Principles: Making Privacy Operational, Version 2.0, May 2007, available online at http://www.istpa.org/pdfs/ISTPAAnalysisofPrivacyPrinciplesV2.pdf (last accessed 27.04.2011)

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main privacy principles were specified. However, in November 2009 the so called Madrid Resolution, a Joint Proposal for a Draft of International Standards on the Protection of Privacy with regard to the processing of Personal Data, was adopted in the International Conference of Data Protection and Privacy Commissioners, held in Madrid on 5 November 2009. One of the objectives of this consensus document was "to define a set of principles and rights guaranteeing the effective and internationally uniform protection of privacy with regard to the processing of personal data."[4] The resolution provided a set of privacy principles classified into several categories including basic principles, legitimacy of processing, rights of the data subject, and security. We observe that, with a single exception concerning the principle of International Transfer, all included principles were covered by some of the privacy principles included in PICOS as a result of the classification provided by the ISTPA document. Hence, we may say that the results of the assurance analysis of PICOS are valid for the Madrid Resolution document. The only missing principle concerns international transfers of personal data, which "may be carried out when the State to which such data are transmitted affords, as a minimum, the level of protection provided for in this Document."[5] This issue was not discussed in PICOS, since all information is kept within the platform at a determined location.

2.2.3 Recommendations for further PICOS development

We give in this sections a series of recommendations based on the results that emerged during the assurance process in PICOS.

Several documents with recommendations targeting privacy, trust and reputation issues with regard to online communities have been produced lately by the European Commission, ENISA and other advisory bodies[6]. We recommend that these recommendations become part of the requirements of the PICOS platform in the future. PICOS should also include among its requirements the principles adopted in the Madrid Resolution.

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[4] JOSÉ LUIS VIVAS, ISAAC AGUDO, JAVIER LOPEZ: *A methodology for security assurance-driven system development*. Requir. Eng. 16(1): 55-73 (2011).

[5] JOSÉ LUIS VIVAS, ISAAC AGUDO, JAVIER LOPEZ: *A methodology for security assurance-driven system development*. Requir. Eng. 16(1): 55-73 (2011).

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Reputation is an issue that should be further researched within PICOS, since there are open research questions concerning reputation that to some extent remain unanswered in PICOS, including the transparency of the reputation system for PICOS users. The rating system is not transparent to users, who do not know how the reputation score is calculated and reputation cannot be customised by the users. No open description of the reputation metrics is available to the users.

Concerning privacy, we believe that PICOS should also develop further the Privacy Advisor. Although privacy is clearly enhanced by the notion of Partial Identity, we consider that the trustworthiness of a system based on this concept is still an open issue that should be further researched in the future.

The notion of partial identities seems also not be very well understood by users in the trials, and it would be helpful if the platform were to make information about his topic available to users online. Finally, multiple forms of authentication should be implemented.

3 Technical results and recommendations

3.1 Community focus

3.1.1 General considerations

During the evaluation process we used on the one hand a top-down approach to determine in how far the Architecture, the Platform and the Client Prototype are able to fulfil the gathered requirements and features of the selected communities. On the other hand, we used a bottom-up approach to evaluate whether the implemented features and functions appropriately put the associated requirements into practice or not. So it was evaluated if the technical implementation of the gathered features and requirements realises the corresponding PICOS specific concepts in an appropriate way. It was not the goal of the technical evaluation of the community focus to evaluate architectural decisions, quality of the code itself or quality of usability.

The sub community features were identified in chapter 3.3.2 “Community focus” of the “Evaluation of the Platform Design & Architecture” of D8.1 as being the key features regarding the community focus. Additionally, the public community and the private room functionality are also part of the community focus.

Therefore it is hard to give special technical recommendations for upcoming projects regarding the community focus of the PICOS project. Other projects will have a focus on different communities and, because of that, different community specific requirements. For instance different communities have different requirements in regard to the treatment of its content elements. Content elements in a community which deals with the medical condition of its members need to be treated with more respect to privacy than content elements of a car community. Hence, we can only focus on general community specific features and requirements.

3.1.2 Functional recommendations

Private Room

Each member of the community must have his own Private Room. The Private Room should be attached to the user in his entirety, not to his different representatives /partial IDs. The Private Room is

an area where the owner is able to store content like diary entries (catch reports), files and photos etc. No other members of the community are able to access the private room. The Private Room can also be used to prepare content for publication.

It should be possible to transfer content from the Private Room to a Sub-Community or to a repository in the Public Community. In PICOS in the Sub-Community or in the repository of the Public Community a copy of the original content is stored.

This concept has to be examined by further research in order to determine what meets the users' needs best, storing a copy when publishing content or setting a reference to the content in the Private Room. Another approach is to make specific content elements visible for external users for a given period of time. This feature has been declined, because it was assumed that it would weaken the Private Room concept. Further research is needed to prove this assumption.

Sub-Community and Shared Desk

The Sub-Community concept introduces the possibility to form a certain group in order to discuss about a specific topic or to discuss with specific people. To achieve this there are public Sub-Communities and private Sub-Communities the users can create.

The private Sub-Community is only visible for its members and is therefore invisible for other users. The administrator of a private Sub-community can invite members from his contact list to become member of his private Sub-Community. The invitee gets a corresponding notification and can confirm or decline the invitation.

A public Sub-Community is visible for all users/partial identities of the community and each partial identity can freely join the public Sub-Communities.

During the development process, a third kind of Sub-Community has been created, the Shared Desk. The Shared Desk is a kind of "show room". The creator can invite other users similar to the private Sub-Community, but these members have a read-only access to the Community.

In PICOS, for all types of Sub-Community, it applies that only one partial identity of a root identity can be a member of the Sub-community. The private and public Sub-Communities offer a forum where the users can create certain threads for discussion. Additionally, the users can publish specified content elements like Catch Reports (in case of anglers) to the Sub-Community. For each publication or post the user can define who can read this resource.

For Sub-Communities and the Shared-Desk especially the access rights do need further research. Especially the way access policies are handled and created has to be examined.

Public Community

The Public Community is formed by all members of the community. The Public Community should offer:

- Links to different components like (in case of anglers) Watercourse Advisor, Species summary etc.
- A Public Forum
- A Public Repository

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The Public Community should contain the same possibility of setting access rights as the Sub-Communities. Additionally it should be possible to create repositories for different content elements. It should be possible to restrict the access to these repositories by setting up policies.

In PICOS, for the second (Online gaming community) prototype a new functionality was added that allowed users to modify the content of a post when it has not been rated yet by other members of the community. Consequently, this new feature offers the user the option to modify subsequently his previously posted contribution.

Similar to the Sub-Community, it has to be examined by further research how users want to use policies to restrict access or if the users prefer predefined sets of policies like the Sub-Communities and Shared Desk offer.

3.1.3 Technical recommendations

Mobile client vs. web access

From D7.2b it can be seen that the sub-community features were used by most of the users participating in the field trials and were often accessed by using the web-frontend.

Taking into account the usability reports that are produced in the frame of WP7, it can be stated that the sub-community feature was a useful community feature for most of the participants. But following D7.2b it is important for the users to have not only the mobile access to the community but also a web-frontend to create postings and other entries. This is because of the fact that creating text entries on the small mobile device is very inconvenient.

Therefore it is recommended for mobile communities to have an additional web-frontend and not only access via the mobile device.

Coordination of platform and client(s) especially for usability purpose

Having a look at the technical implementation process, there are some remarkable issues. Again, due to the fact that we have a given architecture for the platform prototypes and client prototypes in their entirety it is not possible to make a special advice only for the community focused components.

During the implementation, it became obvious that the API description of the platform functionalities should have been more detailed and consistent. Especially for the community focus it can be stated that there were similar functionalities at the public community and sub community level but with a different API. This issue has been addressed during the development process but could not be solved perfectly. Despite this there were functionalities which have not been described sufficiently; there was a lack of semantic description of the parameters, so that it was not clear e.g. what the “requester” parameter should contain; the ID of a user or the requesting platform component.

For further projects it is therefore strongly recommended to describe a detailed and consistent API. It is also strongly recommended to have a detailed UML model as a basis for defining the API; especially with distributed development teams.

The Private Room and Sub-Community components have been implemented by extending an open source community system (elgg[7]). Finally the use of this open source system has had no advantage, because it was only used by these two components and despite the data structure and storage most of its functionality could not be used. But it has to be stated that the customization could be an advantage

[7] For further information about elgg see: http://www.elgg.org

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when most of the components are built as plugins or modules for this community system, because it features a full web access to the community.

Because of the parallel implementation of the platform and client prototype, the client development team had to deal with missing functionalities on the server side which had some impact on the implementation process. During the client implementation, it especially came obvious that some functionalities were not designed to the client's need. Regarding the usability there came some demands during the implementation phase which could not be implemented because the platform did not support the needed functionality.

For further projects it is therefore strongly recommended to integrate usability experts during the requirements and design phase of the project.

3.2 Location data

Location data is highly sensitive user information and needs to be treated in a very trusted manner. If the user gets the feeling that his location information is used in a way he is not aware of and he cannot control or if the information is even misused, a location based service will be rejected. In the course of the PICOS project, several techniques have been implemented and evaluated to protect the information on one hand but also to enable secure services.

The following sections summarize major findings and potential for further investigations.

User Consent and Privacy Advisor

Before any processing of location data is possible, the user's consent needs to be obtained. A major problem was that in all use cases more than one user were involved and needed to be online or available at the same time to allow a synchronous request/response communication. To avoid this necessity, an asynchronous mechanism has been introduced in the second prototype, so that other users, for which the location access is requested, can respond when available. Nevertheless, the asynchronous mechanism prevents a user from continuing with his use case and makes him postpone it to a later time, when all user consents have been retrieved.

In order to improve this situation, more research needs to be done on how to define and set up policies in a more generic way so that valid policy rules already exist prior of their usage. A good balance between data protection and usability needs to be found.

The definition of policy rules in advance was covered in the PICOS prototypes by a privacy editor. The first version turned out to be a bit too complicated to define all aspects of a policy rule in one step. The situation could be significantly improved by introducing a policy wizard with a step by step approach. Here we see an entry point for further simplifications, where the user could be enabled to define more generic rules in an easy manner prior the usage with the help of a wizard. The privacy rules could be defined more related to user groups or the user's context rather than to particular users or fixed situations.

The steps to obtain the user's consent usually hinder the user to proceed with the original task and are somehow felt as an obstacle. Therefore the user often agrees quickly without thinking of all consequences. The introduction of a privacy advisor as the user's best friend makes the user aware of consequences related to his privacy settings in later scenarios and provides a kind of "self healing" mechanism to adapt privacy rules in a more appropriate way to the user's demand.

The privacy advisor concept could be picked up for further research and applied to location based scenarios.

Meeting with nearby Gamers

The gamer application offers the option to search for gamers nearby in order to meet them. A user who wants to be visible to another user needs to allow access to his location, ideally by the whole community. The privacy settings were the same as for the scenario where one user wants to locate a specific other user. A more general privacy policy could be introduced, where unknown users can locate someone only if they are nearby with a different precision. On the one hand this would introduce more freedom to define policies for specific use cases, on the other hand additional complexity needs to be handled in a way that does not confuse the user. Research on finding a reasonable balance and a way to define easy to understand but also powerful enough privacy rules is recommended.

Social Presence Awareness

One major improvement to ease the dealing with policies for different user contexts was the introduction of social presence awareness. This feature enables the user to define special social areas where specific privacy policies shall be applied. For example, the user defines his working place and when he approaches the place, location based privacy policies for disclosing his location are automatically - without any user interaction - considered.

The new concept of adapted policies depending on the user's context frees the user from dealing with privacy policies all the time and adds an additional flexibility for defining rules for dedicated use cases.

We recommend integrating the concept in further research projects to investigate automatically adjusted privacy policies not only with regard to the user's location but also with regard to other context attributes like the presence state, the mobile phone capabilities etc.

The challenge is to find a user friendly and easy to use policy setup for much more complex privacy policies.

Usability and Network Issues

We have seen in the course of the PICOS project and especially during the user trials, that the evaluation of new privacy concepts requires an excellent usability. This requirement contradicts somehow with the status of a prototype, because much effort needs to be spent on the application design. Although we have improved the prototypes by each release, we finally did not end up in an application without any usability issues.

In addition, some problems were out of our control: The LBS scenarios are quite complex and require many client-to-server interactions in the background. During the angler user trial, it turned out that in the regions where the anglers are active, the network coverage is often poor. As a consequence the response times are high and the usability suffers. In order to improve the application, several caching mechanism have been introduced in the second prototype to reduce the network traffic. A fast application with short delays is very important and therefore the data traffic should be as low as possible.

Ratings and Reputation

In the PICOS prototypes, the reputation of a user is derived from the ratings of his contents. The ratings are done anonymously. To achieve a link between the online world and the real world, a recommendation or a rating of a user could be done based on the fact, that two users met each other

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physically at one place. As a proof for a physical meeting, the establishment of a near-field-communication, e.g. a Bluetooth connection, could be used. Then another quality of ratings is possible and could be added to the existing rating. More research on this topic seems to show promise.

LBS Advertising Services

Customers are often used to get location based services free of charge. In order to generate any revenue advertisement is a valid business model. In the second Picos prototype the concept of commercial point of interests (POIs) has been integrated. A commercial entity, e.g. a gaming shop or a wifi hotspot, defines attributes of the target group, e.g. the age or hobbies. If the user opens the map to see nearby users and POIs, the commercial POIs which match the user profile are shown. The user can also recommend such a commercial POI to other user.

Based on the number of recommendations or presentations of POI the advertisement partner can be charged. Further research on how to optimize this business model and how to find an adequate balance between generating revenue and not annoying the user is recommended.

Overall comment

All LBS requirements have been successfully implemented in the course of the two prototypes and were available from the pure technical perspective. However, due to usability and/or network issues the evaluation by end users was difficult. Either the usability could be more improved (difficult for a prototype) or some more training for the trial users to get more familiar with the application and the new concepts are recommended.

4 Usability results and recommendations

4.1 Introduction

The implementation of PICOS concepts was evaluated with two different user groups (anglers and gamer) in different settings (lab and field) with a broad range of different methods (qualitative and quantitative). The first PICOS prototype lab tests and respective field tests with the angling community took place on the 27th /28th November 2009 in Vienna and on the 12th /13th December 2009 in Kiel. The lab test in November took place at the lab of CURE in Vienna and the respective field tests on the next day took place at a fishing lake in Groß-Enzersdorf near Vienna. The lab tests in December took place at the lab of Leibniz Institute of Marine Sciences in Kiel and the respective field test was conducted at two fishing lakes in Jevenstedt, close to Kiel. In total 24 users in Vienna and Kiel have been observed and interviewed to gather the results. Results were reported and recommendations were made to improve the Angler Application v1 (documented in D7.2a). After 5 months the upgraded Angler Application v2 was released and evaluated by 19 users in Vienna and Kiel again. In contrast to the first short term evaluation in a controlled setting, a long term evaluation approach was considered for this second evaluation phase. These field trials aimed first of all to test the PICOS Angler Application under real world settings on a 4-weeks scale, which allows a more thorough evaluation of the user's behaviour compared to the short two-day lab and field tests in November/December 2009. During the field trial phase participants were asked to solve tasks on their own (without the help of the test conductor). They received the tasks via their application. An online questionnaire was sent out afterwards and a final group discussion was conducted to gather users feedback during and after the trials (Organisation and results are documented in detail in D7.2b). In October 2010 the PICOS gamer prototype v1 was released. This prototype was based on the Angler

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Prototype and enriched by gaming specific functionalities collected in a previously conducted requirement analysis. Similar to the first community tests and trials, the Gamer Prototype was tested in a controlled lab setting and during a one month lasting field trial in October/November 2010 in Brno and Vienna as well. In total 26 users participated in the lab tests and 25 participants tested the PICOS gamer application during the following field trial in Brno and Vienna. The results are documented in detail in D7.3.

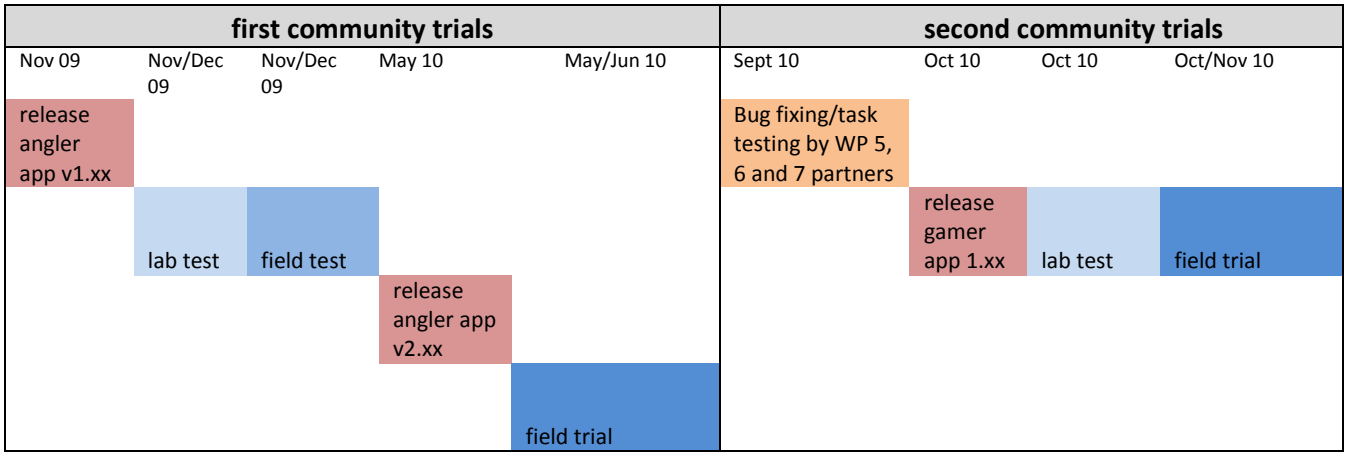

Figure 1: Overview organisation first community vs. second community trials

Based on the experience from the first trial of the angling community and the different arrangements of the work plan for the second community, the second community trial was arranged in a slightly different way described in detail in D7.1. Special effort was applied to the evaluation of the PICOS PET features on a concept level with respect to the difficulties during the first community evaluation phase to gather feedback on PICOS concepts unaffected by usability problems.

4.2 Concepts and usability evaluation of PICOS privacy features

From the results of the first and second community lab tests and field trials it became obvious that technical deficiencies in stability and usability issues of the mobile applications often have camouflaged users' perception of the realisation of the PICOS concepts. Participants' feedback showed that usability constraints have deep impact on the ratings of the PICOS concepts. On many occasions, the trial users were annoyed from failing features; consequently they were busier with mastering the functionalities instead of trying the innovative functionalities, representing the translation of the PICOS concepts into a real world application. Nevertheless, from the numerous interviews, questionnaires and general comments and discussions in pre- and post-preparation meetings with the trial users in Vienna, Kiel and Brno sufficient information was gathered, which allows a quantitative and qualitative classification of the users' opinion about the PICOS concepts, leaving aside the usability constraints. In the following sections user ratings about the PICOS concepts on trust, privacy and identity management should be considered independently from usability constraints in the trials. Additionally, possibilities to improve the implementation of PICOS concepts are recommended.

4.2.1 Feedback on content rating and reputation management

The reputation system was implemented with the aim to support the PICOS community members regarding the reliability of content. This approach followed the example of commercial reputation systems of e.g. Amazon and Ebay. Community members may rate contributions from other member and the resulting rating may increase the trust into an individual member (the higher the reputation, the higher the trust of other members).

Basically, most users were familiar with the value of the reputation of e.g. an online shop or a seller at the e-bay platform. However, during the trials this feature was not used besides the task that requested it. From comments during the group discussion it became obvious that the users of both communities were not really convinced how rating will be accomplished; as an example it was mentioned, that a low rating of a reported fish catch could have significant effect on the members personal reputation, which was not the intention of those who rated the contribution. One participant of the gamer trials in Brno assumed that the application “somehow” rated the person.

Obviously the users were not able to transfer their concept of reputation from commercial services to a social community. Reputation within the PICOS social community context was perceived as a value of a person and was not attributed to specific contributions. Thus, almost all trial users did not apply the rating feature. From an interface design perspective this mental model is probably rooted in the display of reputation directly below the username e.g. on the contacts screen instead of next to the rated content. Additionally to the question of the display of reputation, it could be interesting for further research to examine on what kind of variables a reputation system could be calculated within a social community. The question to what extent a commercial reputation system could be adapted to a social community should be considered in further research projects.

4.2.2 Revocation

This feature allows community members to leave the community without leaving traces (personal information). However, contributions to forums and repositories are not deleted by the revocation process in order to maintain e.g. discussion threads.

This feature, which allows a community member to leave the PICOS community without leaving any personal traces (in contrast to the Facebook policy, for example), was not used in the trials, since the field trial was aiming to have as many active users as possible and it was not desired that trial community members would leave the community. Nevertheless, during the debriefing of the gamer trials questions addressing the revocation of data from the community were raised indicating the relevance of this feature. From personal comments during the angler trials it turned out, that the trial users are very sceptical concerning the promises of online community providers that data are completely withdrawn when a member revokes his membership. The users asked for a mechanism which allows to cross-check whether personal data indeed are deleted or user data is distributed to a number of different servers. This indicates that from a user perspective the feeling of privacy and trust is not only satisfied by individual possibilities to control the release of private data but it also raises questions with regard to the storage of the user data. As this issue falls outside the scope of the PICOS project, it is an additional finding that is relevant for future research in the fields of privacy and trust.

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4.2.3 Private room management (including diary entries and content transfer)

The aim of the private room management feature was to provide a private room, where community members may administrate personal files such as catch reports, notes and pictures with the option to move and release this content in a sub-community and to the Public Community Content Repository.

During the first community lab tests many trial participants did not understand that the "Private Room" hosts the "Catch Diary" and additional notes and files. In general, the submission of a catch record was considered somewhat difficult, mainly because of connection problems; in some cases it was not possible to attach photos. There was confusion on how to make the photo (from the technical point of view). For the following first community field trials, the private room was renamed to "My Catch Diary".

During the first community field trials it was appreciated from the trial users that they may first complete the diary with all the desired information about a fish catch and subsequently decide what kind of information they want to submit to a private or public sub-community. The granularity which allows selecting information for publication was appreciated. Criticism addressed the time consuming typing of a full catch report on the mobile handset. The field trial participants appreciate the web interface of the PICOS angling community in order to be able to add more text and photos in a convenient manner. Typically, at the fishing site, only a photo, the size and the geo location shall be uploaded by using the handset. All other annotations and information was entered using a web browser environment.

For the gamer community lab tests and field trials the feature was renamed to "My Files" according to the requirement of the gamers. The feature was simplified to a simple file upload possibility. My files screen was evaluated as clear, well arranged and easy to use. Suggestions for improvement were made regarding the display of properties of the uploaded file. For instance, some participants suggested a preview or the size of a picture.

Concluding, the possibility to upload files to a private space and transfer and release it later was appreciated by anglers and gamers. For further research it should be taken into concern that the complexity of such a feature implemented on a mobile device should be reduced for an effective usage on the way.

4.2.4 Contact lists management, privacy rules management and privacy advisor

With the help of the Contact lists management, the privacy rules management and the privacy advisor functionalities, it is possible to add or delete contacts in a personal contact list and manage the personal information which is visible to a contact. During the first community lab tests and field tests it was not obvious for many trial participants that the policy creator is behind the wheel icon, placed at the right top of the application. The intention was to indicate the possibility to create privacy settings here but obviously this was not easy to recognize at first glance for the test participants. Furthermore, many participants found it confusing, that there was no acknowledgement with a feedback screen that the rules for a certain profile were changed. It was not clear, that by default, all personal information was hidden to the contacts and that this had to be changed actively for each detail. Horizontal scrolling in order to cross-check the policy settings was confusing (all other functionalities are primarily vertically orientated). Moreover, the participants did not really understand how to operate the policy creator. It was suggested to rename the "policy creator" to "privacy manager", which links to the overview of privacy rules. Additionally, it was recommended that the privacy manager should provide

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a function “add new privacy rule”, which leads to the wizard or screen to create a new privacy rule. To enhance the contacts management, a contact context menu was suggested, that would ease the settings for certain contacts (comparable to “send message” option).

During the following first community trials users had different positions regarding the privacy rules management. About 50% of the users rated the specialised privacy and data protection functionalities of the PICOS application as very important and useful to support privacy. Half of the users were not sure about the concepts or wouldn’t use it. However, those who had doubts about the usefulness of these features noted also, that it is apparently too complicated to handle or they did not even understand these functionalities. It was criticised by the anglers that the important information (the “attribute”) of the privacy manager was not visible in the upright format. The privacy manager was rated as more usable in the landscape format. Some tests participants argued that the list of rules may become confusing if many rules are applied and no feedback was received after successfully generating a rule. The concept of hiding certain information or attributes from certain contacts on a very granular level was in general appreciated very much.

During the second community field trials with the gamer community the Privacy Manager received positive feedback for providing a well-organised overview on the already applied rules. Especially the tab structure of the Privacy Manager was positively evaluated. During the usage (especially during the lab tests), the participants had problems finding where to create a privacy rule (the “Create Rule” Button was overlooked). The Privacy Manager functionalities were expected in the main menu (e.g. in the context menu of the Contacts menu) because the functionality of the Privacy Manager always affects the contacts (in fact their access rights to personal data of the user).

Concluding, the Privacy Manager concept was appreciated by the users but its implementation in the mobile application led to some confusion. The approach to simplify the rule creation process with the help of a wizard should be maintained and could be assigned to the overview of the created rules. Screen changes could hardly be avoided regarding the huge amount of information.

Main critique from anglers and gamers related to the notifications (Privacy Advisor function) because due to technical reasons these notifications (e.g. if a contact tried to locate the user) were displayed when the participants want to logout and were therefore perceived as annoying due to the timing and their amount. Already during the angler trials, the notifications lead to an overwhelmed message box. Concluding from the user statements after the first community trials, the storage of privacy advisor notification is not necessary. Notifications should appear more unobtrusively during the usage of the PICOS application. How to design such unobtrusive privacy hints and warnings without interrupting the user fundamentally is part of on-going research.

4.2.5 Sub-communities management (private and public, including forum, diary entries and files)

The Sub-Communities management feature allows the community members to either create and post in public communities and sub-communities (which are open for all community members), or in private sub-communities where the administrator invites other members to participate. During the initial lab tests with the angling community no major problems were encountered from the majority of the users.

Some suggestions for improvement were made, e.g. the listed forums do not indicate the number of contributions; that would be considered as useful information. Additionally it was remarked that the creator of a contribution is not visible; this information was requested as well as the title of the thread. The test participants asked for an improved graphical layout, such as a clear delimitation between the

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different posts (e.g. alternating grey and light background). New posts should appear in the first position.

The qualitative results of the angler trials showed that the trial users appreciated the privacy enhancing possibility to create private Sub-Communities. They valued the option that a private Sub-Community enables them to discuss certain topics only with selected buddies and friends, and participants can only join upon invitation; in addition it was appreciated, that such private communities are hidden from entire public community. The trial user mentioned a number of opportunities in online communities where they would appreciate such an availability of the private room and private sub-community concept.

During the second community trials the participants mentioned that if private communication was necessary, they used the private Sub-Community. Again the participants appreciated the distinction between private and public Sub-Communities. Some suggestions for improvement were made regarding the feedback if a new post in a subscribed Sub-Community was released, or the placement of the search button on the initial screen. The list of Sub-Communities was expected to be displayed below the search field.

Summarising, most of the private communication among the trial participants was realised with the help of private Sub-Communities. The distinction of public and private community was easy to grasp for the users. For future design solutions, it should be considered that the application should highlight new posts in subscribed communities to support an ongoing communication among the community members.

4.2.6 Location Based Services

The Location Based Services feature allows the users to release watercourse/fishing spots (PICOS angling prototype) or POIs (PICOS gamer prototype), to locate themselves and to locate buddies in their area. Additionally it is possible for the PICOS users to blur their position which means that no exact position is displayed.

The location based services (watercourse/fishing spots management and locate my buddy) including the blurring options were among the most appreciated features in the mobile angling community during the first community field trials. Specifically, the trial users appreciated the option either to restrict unwanted access to their location and fishing spots or to apply a blurring to their location and the location of a fishing spot respectively. Some trial users were specifically interested in the blurring functionality and even suggested improvements such as a different algorithm for the blurred area to avoid that a user could draw conclusions concerning the blurred position of another community member user (in the present version, a simple, randomly distributed rectangle represents the blurring, not taking into account if there is only a small part of the rectangle at the waterfront). Regarding the blurring function the gamers mentioned that the blurring could be improved by adding a broader range to blur their position or set a range on their own.

Here further research may provide improved visualisation methods to improve understanding of the blurring algorithm at first glance. Unfortunately, the LBS features had always problems to work, thus, the trial users were only occasionally able to use these services, which prevented them from a more extensive testing and subsequent feedback. In summary, the LBS services were among the most appreciated features which demonstrate that the users indeed were interested to protect their privacy. Users mentioned they want to hide their actual location and their e.g. favourite fishing spot, or to show their exact position just to good friends to invite then to join for an angling event.

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During the first community lab tests this functionality did not work properly in most cases in the field trial without a clear reproducible pattern (reported from users). It was assumed that either the connection was too slow or it was affected by program bugs (java errors appeared). In some individual cases it was working, and in those cases it was much appreciated from the trial candidates. It was suggested, to allow to be able to locate also previously unknown angling buddies around (those who allow to be located), e.g. in a distance of 5 km (and those who are not in the contact list yet) in order to establish new contacts. If once the blurring function was detected, it was not difficult to apply. However, many trial participants had problems to locate this functionality. The functionality was mostly detected in trial & error mode. Some trial participants expected an exit command behind the "red cross" (which shows up when the location mode is in the "Off" mode), since this is common in the Microsoft Windows environment.

The possibility to locate buddies was mentioned as the most appealing function during the gaming community field trials. Especially at the beginning of the trials the participants mentioned that they used the function to check who is at the university at the same time. Already at the kick off for the lab tests the gamers showed interest on the blurring functionality. The gamers mentioned that the application should save the last status set by the user. The POI function was appreciated by the gamers as well. Especially the fact that they are integrated in the map context menu was evaluated as efficient. Additionally, ordering options were requested with regard to estimated growing content. The POI feature should be maintained in similar applications as a valuable feature from which each individual community member could benefit.

4.2.7 Identity Management Concept

The identity management concept feature allows the user to be a member of the community under different pseudonyms. This function allows the creation of various partial identities within the community and profiles with individual settings per identity.

During the first community lab tests the partial identity concept was either not well understood or the necessity was not accepted. However, the general concept to have different identities for different communities (e.g. Facebook and Xing) with different volume of personal information was very well received. In practice, it was not obvious for participants who were creating a new identity, that some personal data from the root profile cannot be changed, such as age and gender (a trust-enhancing feature in the PICOS community). Some participants expected that the other identity could be set up within the profile of the first identity. Therefore examples of how the partial identity concept could be used in the context of an angling community would be appreciated (IFM-GEOMAR provided sounding examples in the briefing sessions for the field trial). Some participants stated that they would like to have the functionality "new partial id" as a sub-menu of the wheel icon.

After the field trials of the anglers, only a few users stated that they appreciated this idea; others didn't understand the sense behind the use of different identities and some were even strongly declining this function. The degree of agreement to the statement ...*"I like to have different identities to get control over the amount of data shown at a certain point of time and present myself on different platforms…."* (PET-Uses item) was rather low. However, in some post-trial discussions it was considered interesting from a number of trial users that for different communities different identities with different sets of personal information may be of advantage. Other comments from trial users indicated that this concept may become even interesting in the same community in special cases, such as when an angler does not want to be known in his flyfishing sub-community as someone who also tortures worms as bait. In this case, different identities would allow the user to show up in the worm fishing community as well in a flyfishing sub-community without any obvious connection between both identities.

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In practice, it was also not obvious for the users who tried to create a new identity how the root profile is associated to other identities. Some candidates expected that the other identity could be set up within the profile of the first identity. In this case, the feature seems to be too complex to be easily grasped by the users. This is also an example that a feature which isn't understood within seconds is rated as too complicated to use, although in high-level discussions the concept was rated as useful.

During the initial discussion with the gamers before the second community lab tests and during the discussion after field trials it became obvious that the participants were interested in the partial identity feature on a concept level. The participants appreciated the possibility to handle different accounts in one platform instead of cumbersome creation of different accounts related to login with different usernames.

During the gamer trials, the participants stated that they did not create additional partial identities to avoid an increased amount of notifications and they evaluated it as confusing to have several partial identities in addition to their Travian pseudonym. Some of the users remarked that they did not enter profile data (e.g. profile data) at all, if they want to keep it private in any case. The gamers questioned the data security on the server side and raised the question where their profile data is saved, which indicated a much broader experience of privacy and trust. This is not an issue in the PICOS project but could be of interest for further research. The gamers had concerns that if they filled out several profiles, all the saved data would give a full overview on their personal data. This indicates that from a user perspective the feeling of privacy and trust is not only satisfied by individual possibilities to control the release of private data but also a question of the storage of data. It was announced by the test facilitators that this is out of the scope of the project which focuses on the user management side.

4.3 Summary and Conclusions on the PICOS PET features

The first and the second community lab tests and field trials were successfully accomplished during November/December 2009, May/June 2010 and October/November 2010, according to the planned schedule. The majority of the trial users of both tested communities agreed on questionnaire items (PET-Uses) related to privacy and data protection importance such as *"… for me the protection of privacy is an important issue when I use online communities…"* and *"for me data protection is an important issue when I use online communities"*. These results confirm that most of the users of both test/trial communities are concerned about their data protection and privacy, during the usage of online communities.

The PET-USES[8] questionnaire was applied to gather quantitative feedback especially on the privacy functionalities of the PICOS prototype during the lab tests/field trials of both communities. The questionnaire evaluates the extent to which the software assists the user in learning and understanding the specific privacy features of an application. The degree of agreement from the PET-USES questionnaire indicated that the users rated the PICOS application during the first community field trials mostly in between and during the second community field trials "fairly agree" (lab tests) to "not sure" (field trials). In turn this underpins that the implementation of the concepts into functionalities and the design in the PICOS mobile application were partly perceived as good and partly as complicated. The participants stated that in principle the PICOS concepts were interesting but they didn't use the implemented features during the trials to a desirable extend. Only if these new PICOS

[8] WÄSTLUND, E., WOLKERSTORFER, P. AND KÖFFEL, C. (2009) PET-USES: Privacy-Enhancing Technology – Users' Self-Estimation Scale, in M. Bezzi, P. Duquenoy, S. Fischer-Hübner, M. Hansen & G. Zhang, Privacy and Identity Management for Life, 5th IFIP WG 9.2, 9.6/11.4, 11.6, 11.7/PrimeLife International Summer School, pp. 266-274, Boston: Springer.

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PET concepts are presented well and the interactions on them are easy to apply and support to develop an adequate mental model of them, users are going to understand and finally use these concepts.

Many problems which occurred during the field trials concerning the handling of the application became exclusively apparent during an extensive and long-term - thus realistic - usage of the application. Although it was announced before the tests and trials that the PICOS application is still on a prototype level, the users complained about the amount of error messages the long response time of the system which was frustrating for the users especially during the long term usage of the trials. This became especially apparent after the first community field trial: Participants reported to be demotivated to use the application after on-going negative experiences caused by the performance of the application. This resulted in several carry-over effects affects regarding the detailed evaluation of the application especially its PET features on a conceptual level. Participants were not able to give detailed feedback on the PICPS PET features neglecting their negative experiences with the application.

Nevertheless, the trial participants appreciated the several possibilities to control their release of data on a very granular level, which was perceived as not common within a social community. One additional observation was that the feeling of privacy and trust in online communities is not limited to the setting possibilities of data release only. Especially users who are experienced in the usage of online communities question the protection of data on the server side as well. This was the case in both communities. Summarising the results of the initial **angling lab test and field test** indicate that the trial users appreciated the location based services most and could imagine using them for angling specific activities. Additional privacy mechanisms to control the release of location based information such as the blurring functionality were appreciated by the angling community but could not be tested properly during the trials caused by technical difficulties. Regarding the more complex PICOS PET features such as the policy creator were difficult to handle and understand during the first evaluation phase for the users; the concepts are difficult to grasp and a mental model is not easily developed for several reasons described in the section 4.2.4 above. For instance concerning the partial identity concept, it became obvious that the angling community trial participants do not really feel the need to use different identities in the same community. In contrast during the second evaluation phase the gamers mentioned that they would appreciate the possibility of a central management of different identities for different online environments, which makes sense, since gamers certainly are involved in more online communites compared to anglers, which tend to register in one angler online community and stick to this online resource for a longer period. However, the gamers mentioned that further community identities additional to their Travian identity were not created during the trials. They stated they would have afraid of an increased complexity of application usage.

Many of the overal features which were mentioned as a highlight from the angler trial were appreciated by the gamers as well (e.g. private sub-comunities, location based services such as blurring, show contacts on map, the dedicated visibility to other community members etc.).

Although the focus in the PICOS project is not on usability, it has to be considered as prerequisite for privacy enhanced user interfaces and interactions, which is a result of both community tests and trials. Out of the results of both community tests and trials it can be concluded that some basic usability issues had a huge impact on the evaluation of the PICOS Anglers and Gamers Applications and the particular privacy features. Basically the users of the first and the second community stated that the entry of text and information was very extensive and time consuming caused by the handling mobile device and the detailed information which were requested within the application (e.g. diary entries and profile settings). The usage of the application was partly evaluated as interrupting during outdoor activities, due to disruptions caused by the amount of information which was requested. The size of

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the screen elements, such as scroll bars and the main menu tabs, was criticized and should be enlarged allowing a finger touch usage of the application common for today's mobile devices and applications. However, from our experience such discerning on usability on research prototypes is quite commonly. Additionally the correlation of user satisfaction and performance of a system is not linear. Even a few interruptions in workflow can cause a huge effect on the overall user satisfaction.

Furthermore, it could be concluded from the user statements of both trial communities that the mobile application should be characterised by providing information as fast as possible. Therefore, the users during the first and the second community trials suggest the decrease of text/information entries to guarantee an effective and non disturbing handling of the application on the way.

Provision of extended possibilities to enter text/information the users suggest using a web frontend. This may additionally foster the understanding of new and complex concepts introduced within the PICOS project, as the web is a well-known environment for online communities. Although the users showed their interest regarding the PICOS PET features on a concept level during the pre and post discussions of the tests/trials there is a gap regarding their usage during the trials.

Already Berlyne[9] refers in his novelty seeking approach to the correlation of affect and arousal potential of a stimulus. According to his theory stimuli create a feeling of boredom or negative affect (excessive demand) when the degree of novelty is either too low or too high. Transferred to the PICOS project context this could have been of importance for the mentioned results. The implementation of complex concepts such as the Privacy Manager or the partial ID concept into a mobile environment which is additionally demanding due to the dynamic changing context caused a very high arousal followed by negative affect which ended up in a termination of interaction with the application. The users terminated their exploration of the new concepts although they were interested on a conceptual level. The curiosity of the users could be supported by a slight increase of novelty regarding the implementation of new concepts in familiar and less demanding context. We conclude that the usage and the comprehension of PET concepts should be supported by multiple ways to access the community.

Regarding the PICOS PET features implemented in the PICOS angling and gaming prototype we can conclude that the PICOS PET features were interesting for both test groups and especially the gamers would appreciate their implementation in a broader application context, e.g. as an add-on in popular social communities such as Facebook.

5 Gathering angling community requirements: from questionnaire results to functional PICOS features

5.1 Introduction

Since angling per se is an outdoor activity, mobility is important in accessing promising fishing spots and related mobile communication becomes increasingly significant in the angling community. Thus, in combination with the traditional perception of trust, the Angler community was considered as an excellent opportunity to develop, to test and eventually to evaluate and to verify the PICOS concepts on enhanced privacy, trust and data management in online communities and in a mobile environment.

[9] BERLYNE, D.E., Conflict, arousal and curiosity. New York: McGraw-Hill, 1960

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The underlying methodology of gathering requirements within the PICOS project was mainly characterised by collecting end-user requirements. However, input given by end-users was strongly driven by their own experiences and it was expected that breaking innovations are mostly hard to be expressed by the end-user. Thus, the PICOS consortium was required to "translate" user requirements into new concepts which meet the user needs (as concluded by the PICOS consortium from the requirements gathering process) for more privacy-respecting community environments in a user-friendly manner. This chapter presents the results from an anonymous online questionnaire which was broadcasted in the beginning of the PICOS project. The analysis of the users responses were an important background for the development of the PICOS concepts and subsequent functionalities in the mobile angler applications which were tested in lab and field tests and in a 4 –week's user trial at a later stage of the PICOS project. The conclusions of those user trials were compared with the results from the online angler questionnaire in order to evaluate, if the trust and privacy respecting applications which were developed, based on the early acquisition of requirements, have met the user requirements in trust and privacy in practice and in a real world context.

In summary, this chapter provides the final considerations if the requirements which were gathered in the beginning of the PICOS project and used as a sounding basis for the translation into functionalities for the user applications met the users demand and thus were appropriate to evaluate the user's perception of the PICOS concepts.

The evaluation is specifically based on

a) the approaches to gather the community-specific requirements of the Angling Community which are here briefly re-introduced;

b) the results from the anonymous online questionnaire addressing angling community needs for privacy and trust issues which was submitted in the first requirements phase;

c) the results from the lab-and field tests and in the field trial with trial users from the angling community;

The following flowchart (Fig. X) depicts the approach on how to turn user requirements into real applications for the Angler Community which demonstrates the PICOS concepts, the verification steps and the final evaluation of this approach.

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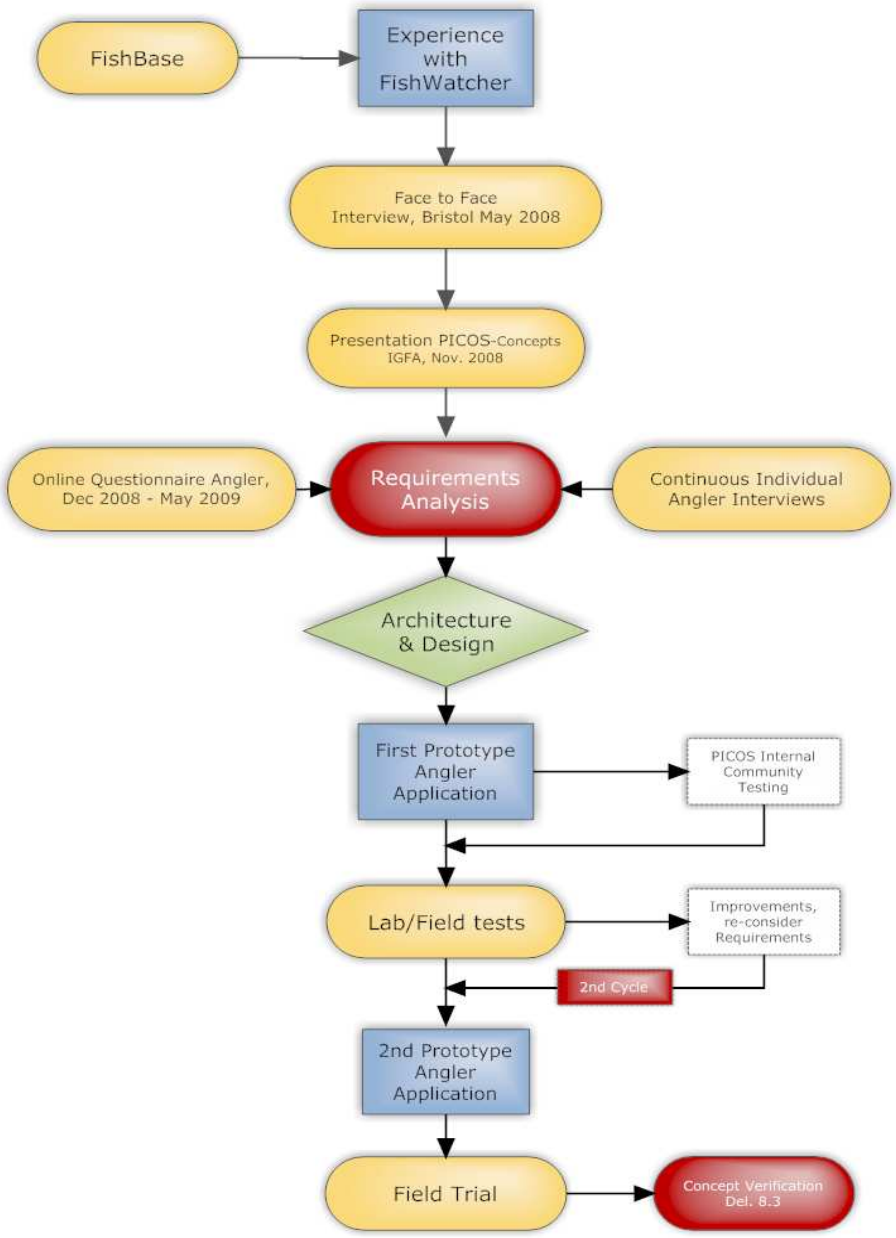

Figure 2: Gathering angling community requirements: from questionnaires results to functional PICOS requirements related to privacy and trust issues in online and mobile communities and subsequent PICOS features and components

This paragraph briefly re-introduces the requirements gathering process. The gathering process benefited from the following applied methods and approaches:

(1) Background and experience of partner IFM-GEOMAR with angling communities;

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(2) Internet-based information system FishBase with the FishWatcher (where angler can upload their observations), a firm starting point for the development of community features following the user-centric approach;

(3) A first face-to-face interview with anglers which was conducted during the Requirements Meeting in Bristol on May 15th, 2008;

(4) Presentation and broad discussion of the PICOS objectives at the 5th World Recreational Fishing Conference, November 10 - 13th, 2008, Dania Beach, Florida, USA;

(5) Communication and dissemination of the PICOS concept and dissemination of a related questionnaire in a number of angling communities and at other angling-related opportunities; feedback and results of a comprehensive questionnaire as an important step to substantiate findings and assumptions;

(6) Personal opinions of and individual interviews with individual angling experts;

(7) Elaboration of end user focused use cases that served as input for development activities.

5.2 Results from an anonymous online questionnaire addressing angling community needs for privacy and trust issues.

Based on the experiences made and feedback received during the interviews and at the World Recreational Fishing Conference, a special questionnaire, targeting specifically the angling community, was compiled as a follow-up of the decision of the PICOS consortium to focus on the Angling Community as first exemplary community during the 3rd PICOS General Meeting in September 2008. The intention of the questionnaire was to gather users opinions about trust and privacy in online communities and to address more specific and functional PICOS requirements related to privacy and trust issues that would lead to concrete PICOS features and components.

The questionnaire had 59 questions in total (52 main questions, 7 questions on Demography) divided into five topics: (1) Demography, (2) Sportfishing & Internet, (3) Privacy, (4) Trust, and (5) Mobility.

The questionnaire was first communicated at the 5th World Recreational Fishing Conference Florida, November 2008; the final version was online since mid of December 2008, well before the commencement of the development of the PICOS platform and the applications. The questionnaire was available in English and German; requests to raise awareness about the questionnaire were disseminated to various angler journals, online Communities (mainly in Germany) and some angler websites. Specifically the distribution of the questionnaire was supported from the online angler communities www.XXL-angeln.de, Ribolovacki Fishing Magazin8, Fishing Magazine International9, Royal-Flyfishing10, European Anglers Alliance (EAA) 6 and the International Game Fish Association (IGFA)5. Since the addressed online communities and magazines for the dissemination of the questionnaire URL represent all age classes (from about age 16 to 66), it was assumed, that the statistical population addressed represents the entire variety of angling communities.

Until May 2009, 111 responses from 9 countries (in and outside of the European community) were received, respondents age ranged from under 20 to over 60 years. Fig. X provides an example how the questionnaire was presented in the Internet.

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The responses of the online angler questionnaire were processed with the Statistical Package SPSS©[10]. The descriptive analysis of the results is being presented in detail in the Annex (x). Where applicable, the responses of the participants in the online questionnaire were compared with the trial user responses gathered in the user trials (based on questionnaires and interviews) in the case of the same or similar questions. The comments of the trial users are based on the evaluation of the angler application in the lab& field tests and in the field trial. With this approach it was possible to evaluate, if the requirements from the first gathering process and the resulting features for the angler application were finally the right translation of the PICOS concepts from the user's point of view.

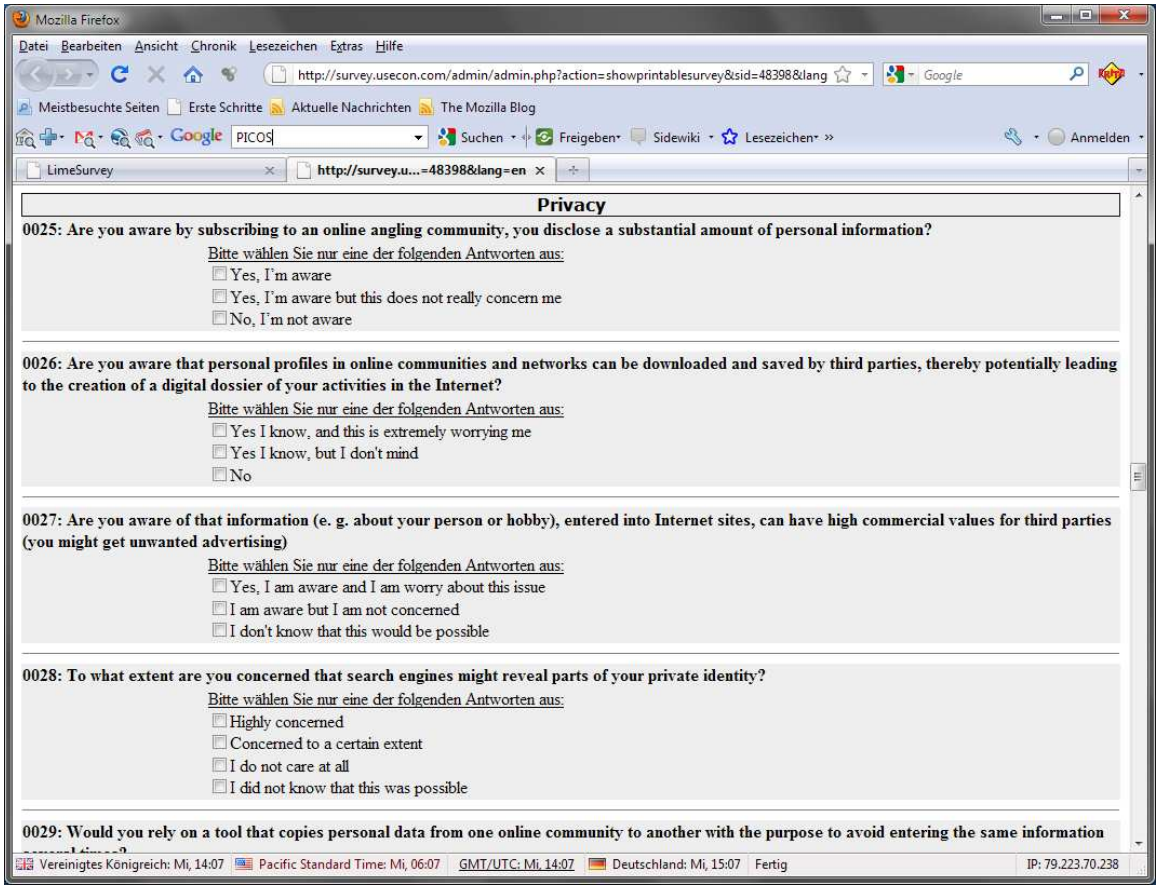

Figure 3: Anonymous online questionnaire[11] addressing angling community needs for privacy and trust issues. An essential step in the requirement gathering process.

An example for this analysis is cited from Graph 16, ANNEX I[12]: the question here was, "Which kind of information about sport fishing would you like to share and with whom? Please indicate in the free text field with which you would share the information (e.g. angling buddies, other anglers at the watercourse, loose friends, online community, buddies from your angling club etc....)".

[10] IBM SPSS Statistics©, /www.spss.com
[11] Compiled by using the Lime-Survey software, http://www.limesurvey.org/
[12] Annex I presents the full report of the analyses of the online questionnaire and the verification in the user trials.

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From the responses it was possible to conclude that in many cases, anglers want to share their information, but rather with known buddies from real world as well as with contacts in online communities with whom they are familiar with due to intensive exchange of personal information. The responses to this question were, for example, a very important driver for the design of improved trust measures of the PICOS angler application. In this case, the user requirements were the trigger for the compilation of the "private room" and "private sub-community" features in the PICOS Angler application.

The related results from the user trials demonstrated in fact, that the most used features were the Public- and Private Sub-Community, the Catch Diary, the Species Summary and the location based services (e.g. locate a buddy, watercourse advisor). Further the users reported that they liked the privacy enhancing features (Privacy Manager), especially the blurring of their own geographical location. The trial users confirmed more or less the opinion of the online participants in the initial requirements gathering process: they are interested to have their private room within the community and just to share selected content with the other community members.

5.3 Results from Lab and Field Tests

The following results are depicted from various questionnaires on privacy and trust compiled from the lab-and field tests and in the field trial with trial users from the angling community in Kiel and Vienna. These results are very useful in relation the responses from the online questionnaire because they can demonstrate that the applications which were provided in the trials, based on the initial requirements gathering process, were an appropriate "translation" of the requirements analysis in the beginning of the PICOS project. The following results indicate that the participants in the trials (in the majority different from the respondents in the online questionnaire) were already sensible for privacy and trust issues (example here from participants in Vienna), very similar to the conclusions from the online questionnaire. This was in fact a favourable condition to compare the trial users' opinion in relation to the PICOS applications with the respondents from the online questionnaire

Statement	Degree of agreement	*M*
For me data protection is an important issue when I use online communities.	"very"	1,33
For me the protection of privacy is an important issue when I use online communities.	"very"	1,42
I trust online communities that they are dealing carefully with my data.	"less"	4,0
I already changed my data protection and privacy settings of an online community.	"in between"	2,5
I like to have different identities to get control over the amount of data shown at a certain point of time and present myself on different platforms.	"in between"	3,18
I like to be informed before when a certain action provides private data and make it accessible for others.	"very"	1,27

Table 1: Results of trust and privacy pre-test questionnaire.

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Summary Lab and Field Tests:

The lab and field test indicated a trend that users appreciated the location based services most and could imagine using them for angling specific activities. The PICOS privacy enhanced technology features such as the policy creator were difficult to handle and are naturally more complex and the concepts are difficult to grasp mentally.

The following list is a summary of the user ranking of the features of the PICOS application which was compiled at the end of all user trials (ranked on basis of frequency):

1. Mentioned 10 times. Map/Location Based Services
2. Mentioned 9 times: Catch Reports
3. Mentioned 3times: Watercourse Advisor
4. Mentioned 2 times: Message Box, Blurring, Species Summary
5. Mentioned 1 time: Community, Public Sub-Community, Privacy Settings, My files, Web-Platform 1

Following things need improvement (ranked on the basis of frequency):

1. Mentioned 3 times: Catch Reports; Map
2. Mentioned 2 times: Species Summary, Graphic Design, Java Script
3. Mentioned 1 time: Watercourse Advisor, automatical Logout, Response Time, Chat, Integration of camera functionality, Private Sub-Communities (invitation), Web (amount of functionalities), Stability of the application

Following things were most annoying for the users (ranked on the basis of frequency):

1. Mentioned 5 times: error messages 5
2. Mentioned 4 times: Message Box 4
3. Mentioned 3 times: graphic design 3
4. Mentioned 2 times: missing information about “news”, Long lasting response time, Chat, Map
5. Mentioned 1 time: Authorisation requests, Java, Functionalities which need a lot of information input, Login, Structure, Not self-explanatory, Mobile Device

User Citations gathered in the lab- and field tests

Some citations, which do not fit in any scheme above, are provided in the following paragraph, demonstrating user´s ad-hoc comments during the accomplishment of the users trial. In the majority they demonstrated, that the translation of the PICOS concepts into applications, based on the requirements gathering process, was successfully realized in order to trial the PICOS concepts.

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I think the pursued strategy of the Picos application is very useful one…If I could use these identities in a simple way and I could define a profile only for my friends who are allowed to know that I´m an angler …at facebook I added only contacts of my working life because I couldn't refuse their friendship request…but I don't want that this people are aware of that I`m an angler because some people think anglers are animal torturers. That's why I never upload angling pictures at facebook. If I have the opportunity to do so by using another Pseudonym I would use it for sure."

The data protection is well implemented in the application (sometimes too good). I received a lot of authorization requests. In combination with the problems related to the message box it leads to the fact that I couldn't receive the trial tasks. That's why I changed my privacy settings and allowed all users to locate me… In my opinion this is not the aim of data protection. I changed my setting because I knew most of the trial participants but in "real live" I would reconsider this kind of setting."

Conclusions Field Trials

The user trial comments are based on the experience of the user with the real application during the various trials and it was interesting to examine, if the features, which were compiled on the basis of the requirement process, were accepted from the trial user in the real world context. Thus, in those cases where the trial results related to topics of the online questionnaire, it was compared to what extend the trial user's opinion matched with the responses of the online questionnaire. In most cases there is a correlation among the responses of the questionnaire participants and the trial user and confirms, that in the early phase of PICOS decisions for features were made, which were finally proven to acknowledge the PICOS concepts. The actual translation into real applications and was in most cases appreciated in the user trials under real world conditions.

5.4 Conclusions and consequences for the PICOS concepts.

The thorough requirements gathering process in the beginning of the PICOS project was an important step on the way to provide finally applications for the angler user trials which met the user's requirements in combination with the "translation" of the PICOS concepts on the improvement of privacy, trust and data management in online communities. To achieve the goal to trial the PICOS concepts in an environment which meets the angler requirements in real world scenarios, various features were realized in the angler application following the preferences of the user's opinions, mainly gathered from the online questionnaire, but also concluded from various face-to-face discussions.

The ultimate aim was to provide the PICOS concepts in an environment (as real applications) which allows the trial user to experience the value of the enhanced privacy in online communities under real world conditions. It turned out, that specifically the online questionnaire was an essential step towards concept building and ultimate feature compilation in the angling application. The majority of the user's requirements which were extracted from the responses in the online questionnaire in relation to an improved privacy found their way into real features in the angling application.

The user trials clearly demonstrated that the translation of the requirements into privacy enhancing features such as "Private Room", "Private Sub-Community", "Privacy Manager", "Partial Identity" and "Blurring of locations" were appreciated from the user as appropriate measures to improve the trust and privacy in social/online communities.

Although the mobile applications were partially rated weak in usability which prevented participants in the user trial from more intensive testing, the overall trial user rating confirmed, that the PICOS

concepts were developed into the right direction to encourage new standards on an improved privacy management in online/mobile communities in general.

6 Economic results and recommendations

6.1 Methodology and documentation used

This final evaluation is conducted mainly via documentation provided by the PICOS development teams, namely the Deliverable series D4.x, D5.x and D6.x, the trial documentation D7.x and the PICOS Deliverable D2.4 "Requirements". The evaluation process was supplemented by interviews with the developers, conducted by the economic evaluator. Additionally the developed prototypes were installed and tested with the focus on the implemented advertising feature and privacy features affecting advertising.

The evaluation is performed taking the view from the today's online community service providers. It is examined how the PET features developed in PICOS would economically affect the service providers in terms of current revenue models and in terms of user satisfaction, due to the service provider's reputation on preserving the privacy of the user. Furthermore the implementation and integration costs for inserting the PICOS PET features into the PICOS Use case scenarios are examined.

In the end, from the service provider's view, the integration of privacy features into existing community platforms should increase the value of existing business models, and support the service provider to be in line with international standards and best practices.

Therefore in this chapter the necessary requirements for privacy enhancement of community platforms are examined from an economic point of view, covering direct and indirect economic impact for privacy adoption in community platforms, as well as software quality and technology aspects.

The first part of the evaluation focuses on an architectural assessment and is based on the work of Boehm[13][14] and McCall[15], how to economically assess software quality impacts, considering costs, product operations, product revisions, product transitions and maintainability of software products. The second part elaborates an organizational assessment, focusing on the service provider's privacy requirements and risks, leading to the cost/benefit trade-off of the business case. Both tangible and intangible benefits of privacy features for community services are examined.

6.2 Use cases and the role of privacy for economic aspects

PICOS Deliverable D4.2 "Platform Architecture and Design 2 identified a set of use cases which describe how the key features of the community would be handled by the architecture. From this set three Use Cases are selected as relevant for an economic analysis, as they describe current revenue models for community services:

[13] BOEHM B. W., R. ROSS, Theory-W Software Project Management Principles and Examples, IEEE Transactions on Software Engineering, v.15, July 1989, p.902-916.

[14] BOEHM B.W., Some Steps Toward Formal and Automated Aids to Software Requirements Analysis and Design, *Proc. IFIP 74*, North Holland, Amsterdam, 1974, pp. 192-197.

[15] MCCALL J., RICHARDS P., WALTERS G., Factors in Software Quality, Tech. Report 77CIS02, General Electric Command & Information Systems, Sunnyvale, Calif., 1977.

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PUC 19: Marketing Advertising:

An advertising service wants to attract gamers for gaming related products and services (virtual items, hardware equipment, etc.). Advertisements are placed based on a set of individual characteristics of players (target profile, e.g. age, hobbies, overall playing time (~ experience)) or average playing time per day/week/month. Advertisements are highly personalized based on these characteristics and based on the context of a user (e.g. location). Players receive a small hint at first, which indicates an advertisement. The advertisement screen further provides a possibility to forward an ad to contacts, which might be interested as well.

PUC 21: Enhanced social ads:

An advertising service wants to attract gamers for gaming related products and services (virtual items, hardware equipment, etc.). Advertisements are placed based on the social and mobile context of players (e.g. current location, characteristics of current friends, location of friends, alliance memberships, playing experience, etc.). Advertisements are highly personalized based on these characteristics players can give feedback on ads (like/dislike).

PUC 23: Advertising Service:

If a player visits an interesting place (e.g., free Wi-Fi access, good restaurant or bar) he/she can mark this place as a Point of Interest (POI) and store it for other members of his/her (sub-) community. POIs can be marked either – private or – public as required by the owner/player who created them.

For current Community Services advertising plays a central role for their revenue model. Social Networks with a business focus (e.g. LinkedIn, Xing, etc.), also rely on charging the users directly but always mix it with revenue via advertisements. When it comes down to personalized advertising, a perceived lack of transparency and control for the user, can lead to distrust towards the community service, which can be a crucial thread for the community service in the end. The implemented advertising service in the PICOS prototypes showed that a community platform provider is able enhance an existing community platform with PET to provide transparency and control to the users and at the same time integrate features for marketers. The PICOS prototypes provide an interface to the users and marketers to configure their advertisement settings via the community client application, whilst the platform enforces the policies and rules, thus providing the user with transparency and control over the usage of his personal data. Although the PICOS prototypes implement strong privacy mechanisms, they are able to integrate features for marketers, and make use of personal information provided by the community. The implemented scenario of commercial POIs showed that context sensitive advertisement is possible even within such a privacy friendly setup.

Along the selected Use Cases for the gaming community scenario, the role of a community service provider is taken, to analyze how PET can provide value to its business:

Members in gaming communities are used to acting as anonymous individuals. The use of pseudonyms is widely spread and accepted, e.g. as the up rise of users showed when Blizzard tried to force the users of the Online Game World of Warcraft to use their real names in the community[16]. One central aspect for Online gamers is to form a virtual identity, which not necessarily has to be a mirror of their real world identity. As online gamers participate in different games and thereby often move between different communities it is important for them to be able to create different identities. A major element of each identity is its reputation in the community. PET features like the PICOS Partial Identities Concept or the Privacy Advisor Component help the user manage his multiple identities. By

[16] KOTAKU, Blizzard Forums Will Soon Display Your Real Name, available online at http://kotaku.com/#!5580585/blizzard-forums-will-soon-display-your-real-name (last accessed on 27.04.2011).

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offering transparency and control to the user's willingness to provide personal information rises, as does the trust towards the community service itself. Based on the gathered information the community service provider is able to generate highly personalized marketing profiles of the users, while preserving trust due to the fact that information is not forwarded to third parties. The community service provider is able to deliver highly personalized advertisements to the users, by that being more attractive to marketeers.

6.3 Architectural assessment

The PICOS prototypes are assessed based on the fulfillment of the functional requirements, such as the privacy enhancement of community services. Based on the Software Quality Model for evaluating COTS Components by Rawashdeh[17], end-users are concerned with observable attributes, such as Functionality, Reliability, Availability, and Efficiency. While from an enterprise view, Maintainability, Scalability, Portability, and Manageability is in the focus.

Maintainability

As for maintainability the PICOS prototypes are based on a component based architecture, defining the interfaces of each component using the WSDL description language and xsd types. This enables the management and audit of the data flows between of system components and furthermore the future maintenance of the components to adapt to new requirements. Furthermore the architecture is divided in a routing layer, a function layer and a data layer, allowing the components to be designed independent from each other, to be distributed on multiple servers and to be easily customizable in terms of inter component communications and component storage.

Scalability

The PICOS prototypes are implemented as web service interfaces, making use of Remote Procedure Calls (RPC) rather than managing protocols for client/server communication, which allows excellent scalability. RPC can be configured to work with Network Load Balancing (NLB). Each RPC client opens a connection pool, with all connections from the pool of the given client ending up on the same server. As long as this condition is met, an NLB cluster can be configured to function as one large RPC server with potentially excellent scalability. Although it has to be stated, that actual performance data is necessary for availability and capacity planning for an increased amount of users.

Portability

Portability is defined as the resources needed to move a system to the target environment, resp. to adapt the target environment to meet the requirements. The efforts for system adoption depend on the IT architecture and application management processes of the organizations involved. Therefore it is difficult to make a general statement how easy it is to port the PICOS platform. Working with existing communities and technologies was part of the PICOS architecture and design process. The chosen PICOS Toolbox approach combined with a service-based architecture supports the portability to existing environments, already suported by the PICOS consortium with porting the PICOS client prototype from the Nokia / Java Environment to an Android environment. The internal and external interfaces of the second platform prototype have been defined using the WDSL language, describing

[17] Rawashdeh A, Matalkah B., A New Software Quality Model for Evaluating COTS Components, Journal of Computer Science 2 (4): 373-381, 2006

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the platform interface in a single WSDL document, offering transparent APIs to other platforms, and being flexible as new features can be added to the platform in future.

Manageability

Manageability includes Flexibility, Reusability, Reliability and Testability. The PICOS architecture was designed with flexibility and reusability in mind. The PICOS design principles make it flexible enough for different system environments and application prototypes, with a component based approach. Reliability was covered via the PICOS assurance process. Refer to the assurance section in this document. Testability in regards to the PICOS prototypes has been covered by the development teams. Each component ran through module testing, creating PHP scripts for each web service entry point of the component. For components that were using other component services, emulation of these components were made available. E.g. in order to validate the 200 web service requests defined in the WP5 PICOS platform interface, a test suite has been developed that covers around 230 usage scenarios.

6.4 Organisational assessment

The business case of applying PET features in community services is examined from a cost impact assessment, to identify where community service providers will possibly benefit from early adoption of privacy enhancement for their community services. As today's community services rely on revenue models based on advertising, a cost impact assessment will help to assess whether community service provider would benefit from the adoption of PET:

Personal Control: Providing the user with more transparency and control over his personal data, he is encouraged to involve himself more in the community. More active members offer more opportunities to present appropriate marketing messages, thereby raising the turnover via advertising.

User Trust: A further effect of providing the user with PETs is that it increases trust of users towards the service provider. A higher trust towards the service provider leads to an increased usage and customer base, as new customers join the community, due to word to mouth.

Risk of perceived privacy breach: If users have the feeling that their personal data is available or accessible to third parties without their knowledge or consent one can talk of a perceived privacy breach, which can be fatal for a community service provider. Implemented PET features help the service provider to manage this risk, reducing organizational costs.

Organizational costs: Integrated PET features allow an automation of privacy policy enablement, which means less reliance upon procedural or organizational measures. This reduces the efforts of the organization, providing more certainty on data protection.

Furthermore, additionally to the benefits of the privacy enhanced community service, the intermediary role of the community service provider for targeted advertising creates further benefits:

Convenience: An intermediary simplifies privacy policies for the user, as he only has to interact with the service provider.

Reliability: The user is not confronted with multiple differing privacy policies of different third parties, but can rely on the service provider.

The role of the service provider as intermediary plays a central role in the PICOS architecture. The privacy of the user is protected by the community platform which is perceived by the user. This will create a positive image amongst the users of a community service and further more will help create a

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positive public image of the community provider. The following highlights the main benefits of a community platform based on the PICOS prototypes:

Reducing risk of damaging the service providers image due to privacy leaks and misuse of user data

Reducing organizational costs for the service provider, by reducing lergal costs for lawsuits or consultancy

Competitive advantage over non privacy respecting community services

Increased usage and customer base

Enhanced and personalized privacy policies will attract more privacy cautious users

But the implementation of PET features developed in PICOS also is related to certain risks for the service providers. PICOS will have to inter-operate with established communities and existing technologies. PICOS architecture relies on certain privacy management components securing the access and communication on personal user data. These components are split up between the platform and the client. The optimal split in functionality between client and server is not obvious. Functionalities can be distributed on the client, the server or both sides, introducing an extra level of complexity. To achieve a deployment of PICOS features in existing community platform technology, existing middleware and services, e.g. services for community management, content sharing, identity management, have to be considered. This means that PICOS has to offer extensions to existing middleware/services, rather than being a set of independent services.

Although costs for adapting existing community platform technologies as Ellg have been shown to be feasible in PICOS, investments for enhancing an existing system environment needs to be evaluated individually.

Furthermore the offered anonymity to users via partial identities may impose problems in case of legal disputes, as users might deceive other users via multiple partial identities, having a negative feedback on the image of the community provider. Active community management and clear rules of behaviour for the community aid the community provider.

Finally the introduction of PET solutions affects various parties and systems throughout the value chain. This integration of all parties and systems will pose limitations and problems increasing the implementation costs for the community service provider. Therefore investments from the intermediary might be delayed.

6.5 Conclusion

Based on the architectural and organisational economic evaluation, we can conclude, that for a community service provider, the benefits of enhancing privacy in an existing community service would outweigh the costs and business process risks associated with implementation. Current community service business models rely on the trust of its community members towards the service provider. At the same time the revenue models rely on enabling marketers to place personalized advertisements in the community. The intermediary role of the service provider addresses both issues in a way that provides a positive benefit for all. The need of the user for transparency and control over his personal data is met, and regarding the marketer, marketing profiles are utilized, to allow the marketer to describe and focus on his target groups. Getting the balance right between protection and usefulness is not easy, and challenging for privacy respecting advertising.

Current community services try to address this issue by enhancing privacy settings for the users, but at the same time deny to take the responsibility as intermediary between the community members and

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third parties like plug-in developers and advertisers, thus losing control, risking the core concept of their business model: The trust of the community members towards the service provider. Therefore a privacy enhanced community service that meets regulatory requirements, the privacy needs of the users, while still enabling existing revenue models is the road to take for community service providers.

Today's social networks providers, act as service providers to Online Communities, relying on the features their community platform provides. Although in 2010 the Social Networks started to enhance their privacy features, they still not support privacy features, as multiple identities and privacy advisor. As more and more specialized communities emerge, the users start to participate in multiple communities at the same time. Existing platforms provide few features to successfully transfer user data between communities or even comply with privacy settings from other communities. The internal and external interfaces of the second platform prototype have been defined using the WDSL language, describing the platform interface in a single WSDL document, offering transparent APIs to other platforms, and being flexible as new features can be added to the platform in future. Flexibility and interoperability is a central success factor for future platforms, as members of a community not only work with one device or technology in one community, but with a wide variety of technology and hardware, switching between various communities.

PICOS showed the technical feasibility and the user acceptance for privacy enhancing features. To help decision-makers, a business case should be built to assess the financial impact of integrating PETs in a community platform. A central aspect of future business models for community services is the intermediary role of the service provider.

7 Legal Results and Recommendations

7.1 Introduction

Compliance to the European legal and regulatory framework on privacy and data protection has been an intrinsic element of the PICOS project. This framework defines the limits within which the PICOS applications should be both designed and deployed. This framework was taken into account since the early stage of the drafting of legal requirements for the PICOS Architecture, the PICOS Platform and the PICOS Application Prototypes to the evaluation of their final versions. The relevant legal framework has been extensively presented in previous PICOS deliverables, mainly in D2.3 "Contextual Framework", D2.4 "Requirements", D7.1 "User Evaluation Plan".

In brief, the legal research in the PICOS project, as well as the legal evaluation of its results, was based on a cluster of relevant legal documents and provisions. The European Convention of Human Rights (ECHR) was concluded in 1950 and aimed at the protection of human rights and fundamental freedoms of the individuals. The right to respect for private and family life is protected in Article 8 of the Convention. At an early stage of technological developments, it became obvious that reliance on Article 8 of ECHR for issues relating to the protection of privacy and data protection in view of technological challenges presented specific shortcomings that had to be overcome. First of all, it was questionable whether Article 8 was sufficient to cover all types of personal data. Secondly, Article 8 did not cover the right of individuals to access their data. Finally, the protection offered by Article 8 does not cover actions that are conducted in the private sector.[18] The procedures set up by the ECHR

[18] COUNCIL OF EUROPE – PARLIAMENTARY ASSEMBLY (Rapporteur: CZERNETZ, Karl), Human rights and modern scientific and technological developments, Doc 2326, 22.01.1968; DE HERT, Paul and GUTWIRTH, Serge, 'Making sense of privacy and data protection: A prospective overview in the light of the future of identity,

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do not allow its direct enforceability from individuals. A complaint against an individual or private party is "*inadmissible for reason of incompatibility with the Convention **ratione personae***"[19].

Convention 108 of the Council of Europe for the protection of individuals with regards to the automatic processing of personal data (CoE Convention 108)[20] was adopted in 1980 in order to cover the gap that was created. As the European Member States did not rush to ratify the CoE Convention108, the European Commission proposed the adoption of a directive that would regulate the protection of individuals in relation to the processing of personal data in 1990. The Data Protection Directive (1995/46/EC) was adopted in 1995 and sets out the general rules relating to the processing of personal data. As already clarified in earlier PICOS deliverables, the ePrivacy and the Data Retention Directives are not applicable to the current implementations of the PICOS project. Both these Directives apply to providers of publicly available electronic communications services in public communications networks, leaving outside their scope private or semi-public services, as well as information society services, and were therefore not specifically examined during the PICOS legal research.

The Charter of Fundamental Rights of the European Union (hereinafter "Charter") was proclaimed and published in December 2000.[21] Since the Treaty of Lisbon entered into force on the 1st of December 2009, the provisions of the Charter became legally binding for all EU Member States and the Charter is considered as the "European Constitution". In relation to privacy and data protection, the Charter provides for the respect for private and family life (Art.7) and the protection of personal data (Art.8).

The legal research of PICOS has been conducted in line with the provisions and principles of the aforementioned legal documents and has contributed to the legally-compliant design and deployment of the PICOS results.

7.2 Privacy by design

The choice of the PICOS project to take into account the legal rules that relate to privacy and data protection from the design phase of the project and to rely on them through all the stages of the design and deployment, not only of the architecture, but also the PICOS platform and Application prototypes, complies with the "privacy by design" principle. The "privacy by design" principle is understood as meaning that "privacy and data protection are embedded throughout the entire life cycle of technologies, from the early design stage to their deployment, use and ultimate disposal".[22] The "privacy by design" principle has been high in the Agenda of the European Commission. The "privacy by design" principle has been promoted in relation to ensuring trust and security in the Digital Agenda for Europe: "The right to privacy and to the protection of personal data are fundamental rights in the EU

location-based services and virtual residence' in INSTITUTE FOR PROSPECTIVE TECHNOLOGICAL STUDIES-JOINT RESEARCH CENTRE (IPTS) (ed) *Security and privacy for the citizen in the post-September 11 digital age: A prospective overview report to the European Parliament Committee on Citizens Freedoms and Rights, Justice and Home Affairs (LIBE)* (2003, IPTS-Technical Report Series, EUR 20823 EN), p. 118.

[19] VAN DIJK, Pieter et al., *Theory and practice of the European Convention on Human Rights* (4th edn Intersentia, Antwerpen - Oxford 2006), p. 29.

[20] COUNCIL OF EUROPE, Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data (ETS. 108) (28.01.1981).

[21] O.J. C 364/1, 18 December 2000.

[22] EUROPEAN COMMISSION, Communication from the Commission to the European Parliament, the Council the European Economic and Social Committee and the Committee of the Regions "A Digital Agenda for Europe" COM(2010) 245, 19 May 2010, p. 17 (fn. 21).

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which must be – also online - effectively enforced using the widest range of means: from the wide application of the principle of "Privacy by Design" in the relevant ICT technologies, to dissuasive sanctions wherever necessary."[23]

Recently, the European Commission discussed the "privacy by design" principle in the frame of the upcoming review of the European Data Protection Directive and the issues that need to be examined in order to develop a "comprehensive and coherent approach guaranteeing that the fundamental right to data protection for individuals is fully respected within the EU and beyond"[24]. The European Commission admitted that "the 'Privacy by Design' principle could play an important role in [ensuring compliance with data protection rules], including in ensuring data security"[25] and is going to examine possibilities for the concrete implementation of the principle.

In the beginning of the PICOS project the legal requirements were drafted, with which the PICOS Architecture, as well as the PICOS Platform and Application Prototypes, should comply. In this way, PICOS realised the privacy by design principle and ensured the compliance of its results with the existing European legal framework on privacy and data protection. The evaluation of the results of both development cycles was conducted against these requirements and specific issues were dealt with during the deployment of the prototypes. Mainly, the legal evaluation focused on the compliance to the data protection principles (specifically the principle of fair and lawful processing, the principle of obtaining data only for specified and legitimate purposes, the principle of data minimisation, the principle that personal data shall be accurate and, where necessary, up-to-date, the principle that personal data shall not be kept for longer that is necessary for the purposes and the principle of data security. The legal evaluation of the results of the first cycle of PICOS (PICOS Platform Design & Architecture, PICOS Platform Prototype and Angling Community Prototype), as included in Deliverable D8.1 "Legal, economic and technical evaluation of the first platform and community prototype", concluded that PICOS is designed and deployed respecting the data protection principles and the protection of the rights of the data subjects in PICOS.

7.3 User control via the Policy Manager

A major contribution of the PICOS project to the enhancement of the protection of the privacy of the users and the strengthening of their control over their personal information is the Policy Manager. The Policy Manager enables the user on the one hand to create rules about his Presence, Location or Profile information, for a contact, a Sub-community, or the whole public community and on the other hand to modify or delete them at a later stage. The configuration of policies via the Policy Manager expresses the consent of the user to the processing of his personal data for specific purposes. For instance, the policy manager has been found very useful in relation to the processing of location data of the users for the provision of a location based service. The user consents to the processing of his location data defining the details relating to location and is given the opportunity to even blur his location in order to protect his location privacy.

[23] EUROPEAN COMMISSION, Communication from the Commission to the European Parliament, the Council the European Economic and Social Committee and the Committee of the Regions "A Digital Agenda for Europe" COM(2010) 245, 19 May 2010, p. 17.
[24] EUROPEAN COMMISSION, Communication from the Commission to the European Parliament, the Council the European Economic and Social Committee and the Committee of the Regions "A Digital Agenda for Europe" COM(2010) 245, 19 May 2010, p. 4.
[25] EUROPEAN COMMISSION, Communication from the Commission to the European Parliament, the Council the European Economic and Social Committee and the Committee of the Regions "A comprehensive approach on personal data protection in the European Union" COM(2010) 609 final, 04 November 2010, p. 12.

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7.4 Targeted advertising

A major contribution of PICOS in the research on mobile social networks lies in the advancement of privacy friendly methods for the provision of targeted advertising. Such targeted advertising can be achieved either as direct marketing from the marketer or the advertiser to the user (B2C communication), or in the form of viral marketing from a user to another user (C2C communication). The techniques developed for the delivery of targeted advertising do not necessarily respect the privacy of the users. A prominent example is the Phorm technology that resulted in the referral of the United Kingdom to the European Court of Justice on the way it transposed the European rules relating to the confidentiality of communications.

"Phorm" functions by taking a copy of the information that passes between end-users and websites, which involves the use of Policy Based Routing (PBR)[26] or Deep Packet Inspection (DPI).[27] Each user is allocated a unique identifier, a unique number, which is stored on their computer in a cookie.[28] Phorm technology examines the browsing habits of users in order to determine categories of information, in which they are interested, known as "channels". These channels are associated with the browser's unique identifier, so that advertising can be targeted to the user's interests.[29] The U.K. telecommunications operator, BT, carried out in 2006 and 2007 two trials of Phorm on its broadband customers, without informing them and obtaining their prior consent. In the end of 2008, BT carried out a new trial of the Phorm technology, for which the consent of the participants was requested. Since April 2008, when it was revealed that BT had secretly carried out the Phorm trials in 2006/2007, the European Commission received numerous questions from U.K. citizens and Members of the European Parliament and started an investigation on the way how the U.K. has implemented the European provisions relating to the confidentiality of communications. This investigation led to the initiation of a legal action against the U.K. and its referral to the Court of Justice.

The example of Phorm illustrates the degree to which the privacy of the users can be infringed via targeted advertising techniques. The abundance of personal information on the users, their interests and their relation that is currently available in existing social networking services, makes the ground fertile for such infringements. PICOS, as a platform that values the privacy of its users, introduced a privacy-enhanced model for targeted advertising in both aforementioned expansions, B2C and C2C. The legal evaluation of these models resulted in specific suggestions for the improvement of the systems and criticised the deployment of viral marketing techniques in PICOS applications.

7.4.1 Business to Consumer (B2C) Communication for advanced targeted advertising

The current deployment of direct marketing techniques is based on the direct communication between the advertiser and the user. Instead of enabling such direct communication, PICOS proposes that the

[26] According to the Glossary of the company CISCO, Policy Based Routing is the method of using route maps to alter the route selected for a packet, available online at http://www.cisco.com/en/US/docs/switches/datacenter/sw/5_x/nx-os/unicast/configuration/guide/l3_glossary.html (last accessed on 23.03.2011).

[27] CLAYTON, Richard, *The Phorm "Webwise" System (last revised 18 May 2008)*, p. 2, available online at http://www.cl.cam.ac.uk/~rnc1/080518-phorm.pdf (last accessed on 23.03.2011).

[28] CLAYTON, Richard, *The Phorm "Webwise" System (last revised 18 May 2008)*, p. 3, available online at http://www.cl.cam.ac.uk/~rnc1/080518-phorm.pdf (last accessed on 23.03.2011).

[29] For a detailed technical description of Phorm, see CLAYTON, Richard, *The Phorm "Webwise" System (last revised 18 May 2008)*, available online at http://www.cl.cam.ac.uk/~rnc1/080518-phorm.pdf (last accessed on 23.03.2011).

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social network provider serves both the advertisers and the consumers, while respecting their specific interests (e.g. privacy of users). "In particular the PICOS platform needs to provide on one hand an interface for advertisers, which allows them to configure what they want to advertise and to whom. On the other hand the provider needs to identify the users for which a particular advertisement might be relevant and provides them with this advertisement"[30]. The legal research in PICOS examined the compliance of the model for B2C Communication for advanced targeted advertising that was developed in PICOS and came to some interesting legal findings.

Article 5(3) of the ePrivacy Directive is applicable to any entity that stores information or gains access to information that is already stored in the terminal equipment of the user and specifies that such actions are only allowed on condition that the user has given his consent, after having been provided with clear and comprehensive information. One interesting issue that came up in the application of this provision related to the concept of "terminal equipment". The PICOS Architecture allows for the storing of user information both at the client, as well as at the server side. While the gaining access to information that is stored at the client side by the social network provider falls undoubtedly under the provision of Article 5(3) that requires the consent of the user, it is questionable whether the storing of information at the server side fulfils the conditions for application of the provision. Our suggestion is that even in this case, the concept of the terminal equipment should be understood in a broad way and the consent requirement should apply. In any case, there is fertile ground for future legal research in cases where the "terminal equipment" of the users does not comply with the traditional model of a pc, laptop, handheld device etc.

The legal evaluation examined whether the processing of user information by the social network provider for the delivery of targeted advertising in the PICOS model fulfils the two conditions set out in Article 5(3): (a) the user has given his consent to the processing of his data for targeted advertising purposes, and (b) the user is provided with clear and comprehensive information that the data will be processed for targeted advertising purposes. The current process for setting up a rule by the user via the Policy Manager that allows the processing of his information for targeted advertising purposes is in principle in line with the conditions of Article 5(3). However, in view of the fact that PICOS aims at the offering maximum protection to the privacy of the users, it has been recommended that, when the user wishes to establish a rule for targeted advertising, he is provided with clear and comprehensive information, possibly via a pop-up. The information should cover not only the types of his data that are going to be collected, but it should also specify that the data are going to be used for targeted advertising purposes. Additionally, the consent of the user should be obtained before the social network provider realises any matching activity. The creation, configuration and activation of the relevant rule can be considered as consent of the user to the processing of his data for targeted advertising purposes. The consent of the user can be valid for subsequent collection of data for targeted advertising purposes, but only for a limited period of time, for example one year.[31] Finally, the user should be given the opportunity to amend the targeted advertising rule and object to the further processing of his information for targeted advertising purposes. These recommendations should be taken into account not only for future deployments of PICOS applications, but for future research on targeted advertising techniques in general.

[30] D4.2 "Platform Architecture and Design 2", p. 125.

[31] The Article 29 Working Party made a similar suggestion for the expiration of cookies that are used for targeted advertising purposes: ARTICLE 29 WORKING PARTY, Opinion 2/2010 on online behavioural advertising, WP 171, adopted on 22 June 2010, p. 16.

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7.4.2 Viral Marketing – Consumer to Consumer (C2C) Communication for advanced targeted advertising

PICOS is designed to support also Consumer to Consumer (C2C) communication for targeted advertising. The PICOS model for C2C communication is based on the principle of viral marketing and allowed the marketing message to be spread among the PICOS users. The PICOS deployment of viral C2C advertising enables various methods, such as the spreading via a context link on a specific website or the use of banners with possibility to forward.

The PICOS model for C2C targeted advertising, wishes "not only to identify adequate users and provide them with the advertising message, but also to provide or support a motivation to these users to forward the advertisements they receive".[32] The legal evaluation examined the value of offering such viral marketing techniques for a privacy-friendly identity management system. The legal evaluation analysed the relevant provisions that are applicable for the sending of targeted advertising via viral marketing and came to the conclusion that depending on the technologies used, the PICOS users should either give their consent to receiving targeted advertising messages or they should be given a means to express their objection to receiving such communications. The proposed model in PICOS does not seem to provide such alternatives or promote the protection of privacy of the PICOS users. Therefore, the legal evaluation recommends the abandoning of the adoption of viral marketing techniques in their current implementation for PICOS. This could be an interesting area for conducting further research on.

7.5 Conclusions

The protection of the users stands high in the values of the PICOS project. Abiding by the "privacy by design" principle ensured the compliance of the PICOS results to the data protection principles and the safeguarding of the privacy of the user. The legal evaluation focused also on specific issues that arose in relation to PICOS. The configuration of policies via the policy manager is a valuable tool for the users to control and monitor the transmission and processing of their personal data. For instance, the policy manager gives the opportunity to the users to specify the conditions on which their location data will be transmitted for the provision of a location based service. Specific recommendations were made in relation to the offering of targeted advertising via B2C communication, while the offering of viral marketing techniques in PICOS was criticised and it was recommended that they are not implemented. PICOS identified areas for future research especially regarding the offering of targeted advertising in privacy-friendly identity management systems, which can serve as an inspiration for future research projects.

8 Conclusions and open issues for further research

Principal objective of the PICOS project was to develop an open, privacy-respecting, trust-enabling identity management platform that supports the provision of community services. To achieve this objective, the PICOS consortium realised multi-disciplinary evaluations of the PICOS results in two cycles. This present deliverable contains the experiences deriving from the evaluation of the PICOS results (PICOS design and architecture, PICOS platform prototype, PICOS application prototypes) and contains recommendations for future implementations of privacy- and trust-enhancing identity management systems in Europe.

[32] D4.2 "Platform Architecture and Design 2", p. 129.

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The PICOS project paid special attention to the value of **assurance**. Assurance aspects were integrated early in the project, i.e. during the project concept and initiation phase. The assurance activities were properly phased, with the design phase preceding the implementation phase and prototype construction in a two-cycle approach. The holistic approach adopted was beneficial for the assurance work, and bringing assurance aspects early in the project has clearly helped in eliminating many risks and threats already at the design phase. The recent developments relating to privacy and trust within the European Union, such as initiatives and guidelines from ENISA, as identified by the assurance team, should be taken into account in future implementations of PICOS or similar identity management systems. The assurance evaluation identified the need for further research relating to reputation and the relevant rating systems. Moreover, the concept of the Privacy Advisor, which presents a significant added-value for PICOS, should be further researched in the future. Finally, multiple forms of authentication should be implemented in future implementations of PICOS.

The **technical** evaluation focused on various aspects of the PICOS results.

The technical evaluation conducted with a **community focus** revealed that it was very beneficial to allow the users to transfer content from the Private Room to a Sub-Community or to a repository in the Public Community. Further research is needed in order to prove whether the assumption made in the PICOS project that making specific content elements of the Private Room visible to external users would weaken the Private Room concept. The PICOS project made extensive use of the concepts of Public Community, Sub-Communities and the Shared Desk. However, further research is required, especially on how access policies are created and handled. The PICOS evaluation resulted in the recommendation that mobile communities should have a web-frontend and not only be accessible via a mobile device. The evaluation concluded with the recommendation that future projects with a community focus and identity management systems describe a detailed and consistent API. Finally, it recommended the integration of usability experts during both the requirements gathering and design phase of the systems.

The technical evaluation relating to **location data** focused on the importance of the user consent. The PICOS project, valuing the privacy of the users, allows the provision of location based services only after the user has given his consent. This was realised via the introduction of an asynchronous mechanism, which raises the limitation that a use case is postponed until details of user consents have been obtained. Future research is needed in how to define and set up policies in a more generic way in order to overcome such limitations. Similar to the findings of the assurance evaluation, the technical evaluation relating to location data recommended also future research on the privacy advisor and its specific application to location based services, as well as on the privacy advisor itself. The PICOS project introduced the social presence awareness concept, which was found to be very beneficial. It is recommended that the concept is integrated in future research projects that can focus on the investigation of automatically adjusted privacy policies not only relating to the location of the users, but also with regard to context attributes, such as presence state, mobile phone capabilities etc. In general, further research is needed on finding the balance between the privacy of the users and the processing of location data of the users for the enhancement of additional functionalities of location based services.

The **usability evaluation** of PET features revealed that the users appreciate enhanced PICOS privacy mechanisms, such as the blurring functionality, communication using the private sub-communities and the privacy management on a granular level. However, it was difficult for the users to understand the concept and value of some PICOS features (e.g. the partial identity concept) especially during the first community trials. The usability evaluation of the PET features was partly overlapped by effects of overall device related usability and performance problems particularly during the field trials. The

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separate conducted concept evaluation during the second community lab test and field trials showed that the users appreciate the implementation of PICOS concepts in a broader application context than a singular community specific platform. Furthermore multiple ways of accessing the platform (e.g. via web frontend) are appreciated by the users. Further research especially on quantitative methods should be conducted to facilitate measurement of satisfaction of users regarding usability with research prototypes. Common methods measuring user satisfaction with usability are mainly developed for an industrial context and results are hard to interpret in a research context.

In the beginning of PICOS there was an anonymous **online questionnaire** broadcasted, which aimed at the gathering of user opinions about trust and privacy in online communities and at addressing more specific and functional PICOS requirements related to privacy and trust issues that would lead to functional PICOS features and components. The results of the questionnaire demonstrated that concepts on improved trust, privacy and data management in online communities should be developed in close co-operation with the requirements of end-users. It also showed that the PICOS approach to translate user opinions on trust and privacy from interviews and questionnaires into "real world applications" was successful. Based on the results of the trials (users rating) the PICOS project was able to evaluate and to verify that the translation of the requirements as concluded from the requirements gathering process into functionalities were in the majority successful.

The **economic evaluation** showed the importance for the community service providers to take the role as an intermediary when offering third party services. By preserving data sovereignty, the community service provider avoids privacy breaches and misuse, and provides the user with control over his privacy and data. This helps to preserve the trust between the community members and the service provider. The PICOS project demonstrated the technical feasibility of privacy enhancing features, especially relating to the delivery of targeted advertising in a privacy friendly way. Further research is needed in the assessment of the financial impact of integrating Privacy Enhancing Technologies in community platforms and in the role that a service provider can play in them. Further research is recommended on the optimisation of business models for the delivery of targeted advertising in a privacy friendly way.

The compliance to the "privacy by design" principle ensured the legal compliance of the PICOS results to the data protection principles and the safeguarding of the privacy of the user, as demonstrated via the **legal evaluation**. The configuration of policies via the Policy Manager has been a valuable tool for the expression of user consent for the processing of their personal data and it is recommended that the concept of the Policy Manager is further exploited in future research. It was recommended that further legal research is conducted on the refinement of offering targeted advertising via B2C communication in a privacy-friendly way, while the offering of viral marketing techniques in PICOS was criticised. It is therefore recommended that viral marketing techniques are not implemented in privacy-friendly identity management systems, at least in their current implementations. There is, thus room for future research in this field.

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Appendix A

The online questionnaire was compiled and released in the requirements gathering period of PICOS. Many of the results and user comments were considered in the PICOS concept compilation, architecture and subsequent programming of features for the PICOS mobile application which were tested in the user trials. Along with the annotations on the questionnaire results, it was mentioned which features of the PICOS application have been selected from those responses of the questionnaire participants.

In order to verify if the selected PICOS applications, based on the responses of the online questionnaire, were useful under real world conditions, the user opinions from the trials were allocated to the respective question in the online questionnaire (mentioned as "Related Results from the User Trials").

1. Demographic questions

Some demographic questions aimed to acquire information about the background of the participants, such as country of origin, age and income. This information is useful to evaluate the potential financial background which e.g. allows purchasing rather expensive types of smart phones which is important information related to the goals of the PICOS project.

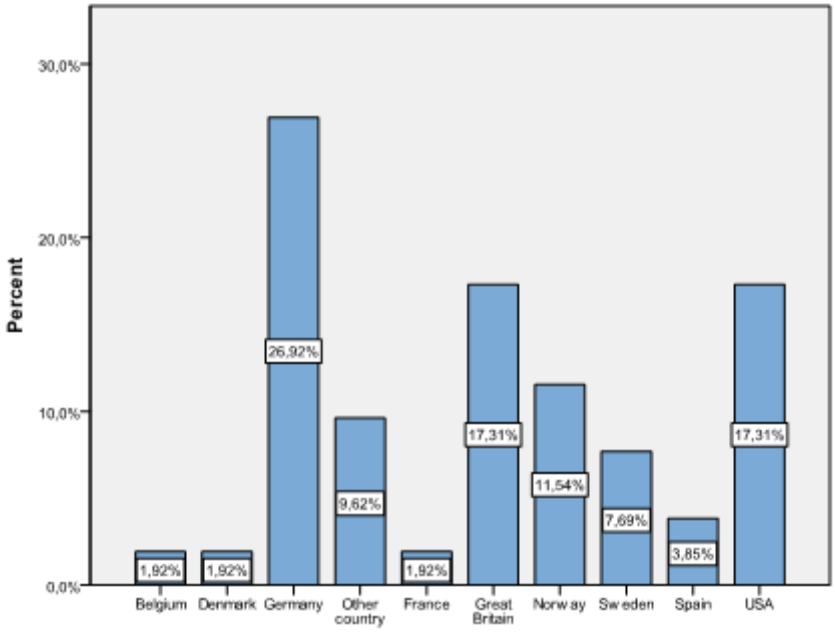

Figure 4: In which country are you resident?

This question aimed to get an idea, where the responses were coming from. In total, responses were achieved from 9 countries plus some other countries. Since recreational angling has pretty different social reputation in different countries it is useful to consider responses across Europe and even from the US. The significant number of responses from the US are due to the participation of IFM-GEOMAR representative and presentation of the PICOS Community Concepts at the 5th World Recreational Fishing Conference, November 10 - 13th, 2008, Dania Beach, Florida, USA.

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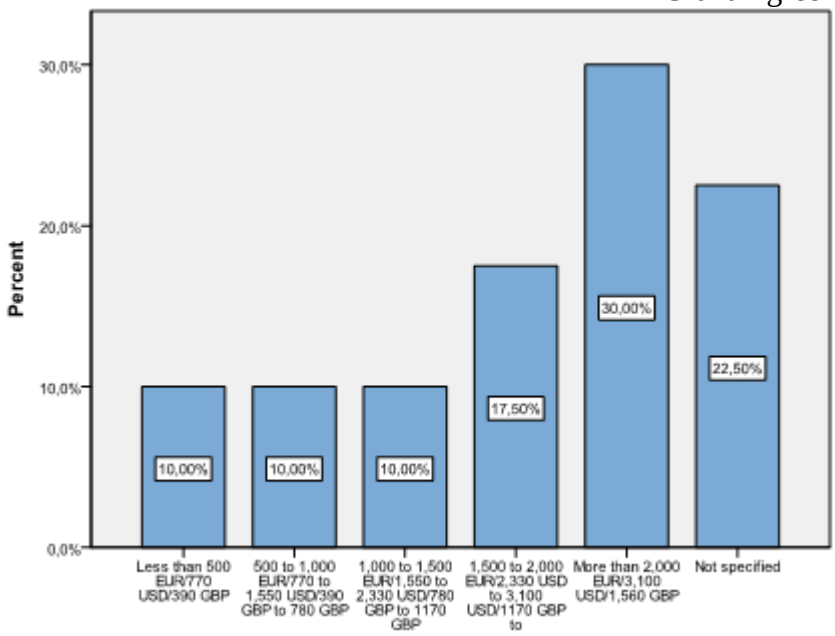

Figure 5: How much money do you have monthly at your disposal?

The question about the range of the income of the respondents was not specified from 23% of the participants, which reflects a common behaviour. Nevertheless, it is obvious, that most of the participants are supposed to be able to afford rather expensive mobile devices. This confirms, that there is hardly a bias in relation to questions, where participants were asked what kind of devices they want to use in relation to outdoor activities like angling. Apparently most of the participants would be able to purchase an advanced smartphone.

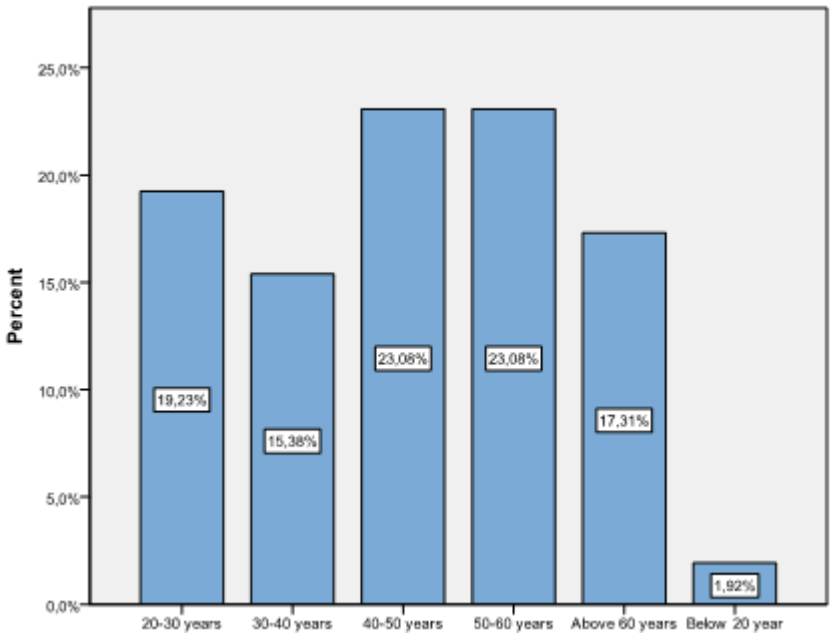

Figure 6: Age of the participants

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The majority of the participants were between 20 and 60 years, reflecting well the age structure in real world angling communities. Angling is an activity which is not limited to a certain age range (compared to the gaming community, where participants are in the majority rather young). Virtually, all age-groups are participating; in fact, angling is being considered as a life-long pastime activity, creating very stable real world communities, which was a significant reason to target the angling community in PICOS.

Related Results from the User Trials:

The selection for the participants of the PICOS Lab- and Field Tests and the Field Trials in Kiel and Vienna had been accomplished with respect to the following characteristics:

- Being an active angler
- Interested in innovative and mobile technologies
- Experienced in using mobile phones
- Participants can deal with an application in English
- Diverse demographic background
- Some anglers should already know each other

In Vienna, finally twelve persons, nine male (75%) and three female (25%) in the age of 22 - 36 years (M = 24,41) participated. In Kiel, 12 persons, only male in the age of 18 - 55 (M = 29,83) years participated.

With this background of the participants and the related age range, the trial participants were in a similar range compared to the participants in the online questionnaire and it is certainly valid to consider both groups as random samples from the same population.

2. Sportfishing & Internet

Related to the topic “Sportfishing and the Internet”, there were in total 24 questions, the results for the majority of these questions is being presented here. This topic was chosen in order to get an impression to what extent angler are using the options which are available in the today’s Internet and what kind of applications, community memberships etc. are being used. The results from these questions were considered as a very important input for the conclusion on the requirements of the angling community related to the subsequent design of the PICOS applications.

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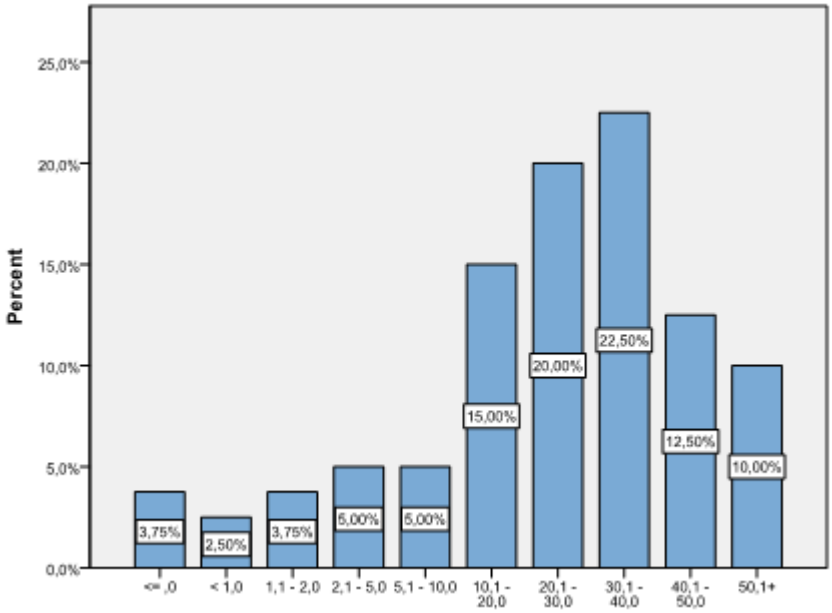

Figure 7: For how many years have you been practising sportfishing actively?

Most of the participants were very experienced angler which demonstrates that even the older, very motivated angler are significantly interested in supplementary tools that could enable angler to catch more fish and have more fun doing it. Concluding from the participation of many of the individuals who responded to this questionnaire, the angling community apparently would you take advantage of such new tools.

Related Results from the User Trials:

The trial participants reported that they are mainly interested in "sports" (75%) and "travelling" followed by "computer" (50%), "education" (50%) with all trial users are active angler with angling being in most cases the leisure time activity with the highest priority. The participants had different angling experience ranging from 12 - 49 (M = 21,75) years; the mean value compares to the results of the participants in the online questionnaire.

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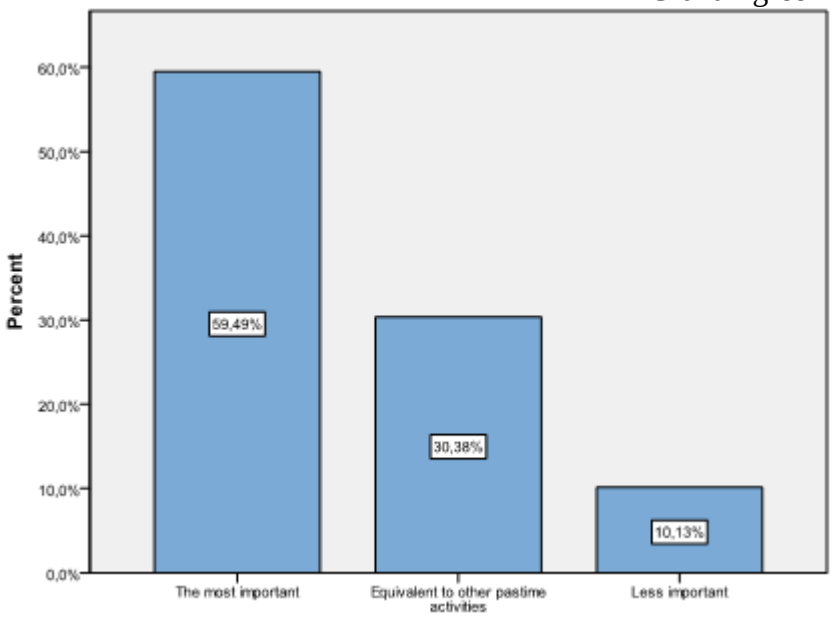

Figure 8: Is fishing the most significant pastime activity for you or just one activity among others?

For the majority of the respondents, fishing is the most important pastime activity, indicating that the results of this questionnaire were highly relevant for the design of the PICOS angler applications which were designed to be useful in real world scenarios.

Related Results from the User Trials:

All trial users are active angler with angling being in most cases the leisure time activity with the highest priority, which corresponds to the statement of the participants in the online questionnaire.

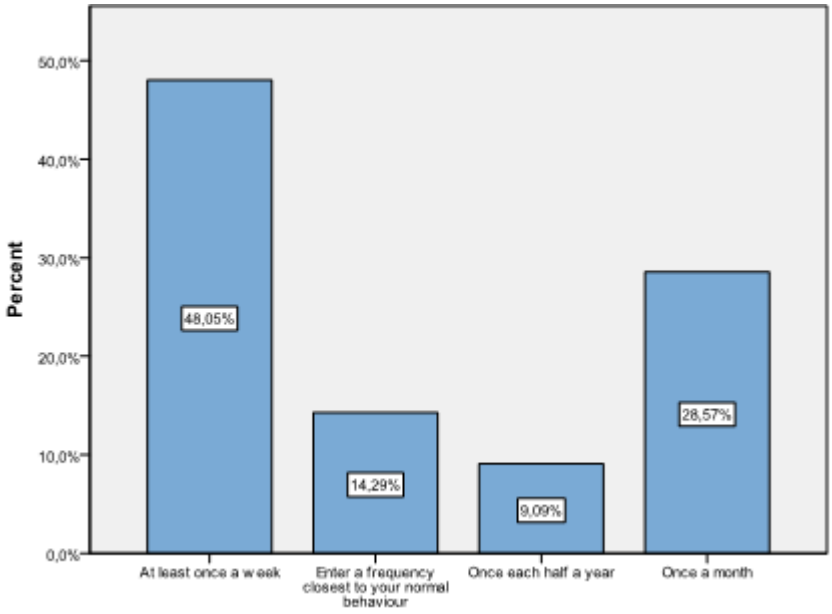

Figure 9: How frequently did you go fishing during the last two year?

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Considering the replies to the questions above, it was not a surprise that most of the participants are frequently out for fishing. Thus, there comments and answers were highly significant for the design of the PICOS angling community application.

Related Results from the User Trials:

On average the participants of the user trials went fishing 1-3 times per month. They spend on average 5,5 hours with fishing. All participants (100%) answered to the question what could be a reason to deter them from angling: “having not enough time”.

The angling frequency of the participants in the online questionnaire was significantly higher compared to the participants in the user trial. However, the reason given for not being fishing more frequently was the same“lack of leisure time…”.

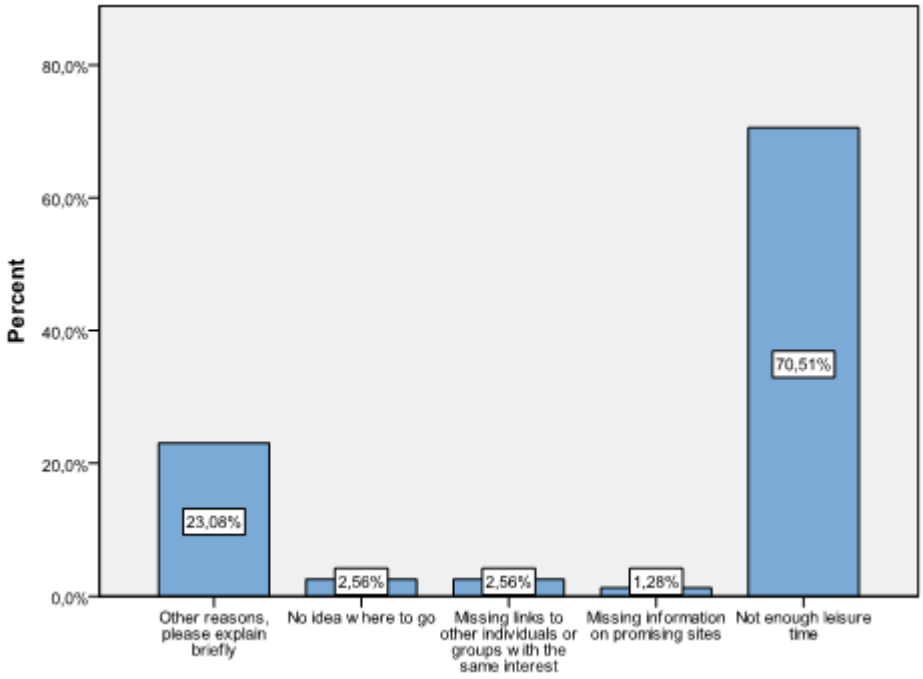

Figure 10: Which obstacle would prevent you from increasing your fishing activities?

This result clearly underpins the significance of angling as the major lesiure time activity; those who are dedicated to this hobby frequently go fishing and just other responsibilities prevent them from being out for fishing more frequently.

Related Results from the User Trials:

The majority of the participants answered to the question what could be a reason to prevent them from angling: “having not enough time” (91, 67 %) followed by “no friends with the same interest” (16, 67%).

The major reason for the limited number of fishing trips was the same as mentioned in the online questionnaire (70% replied “not enough leisure time…”).

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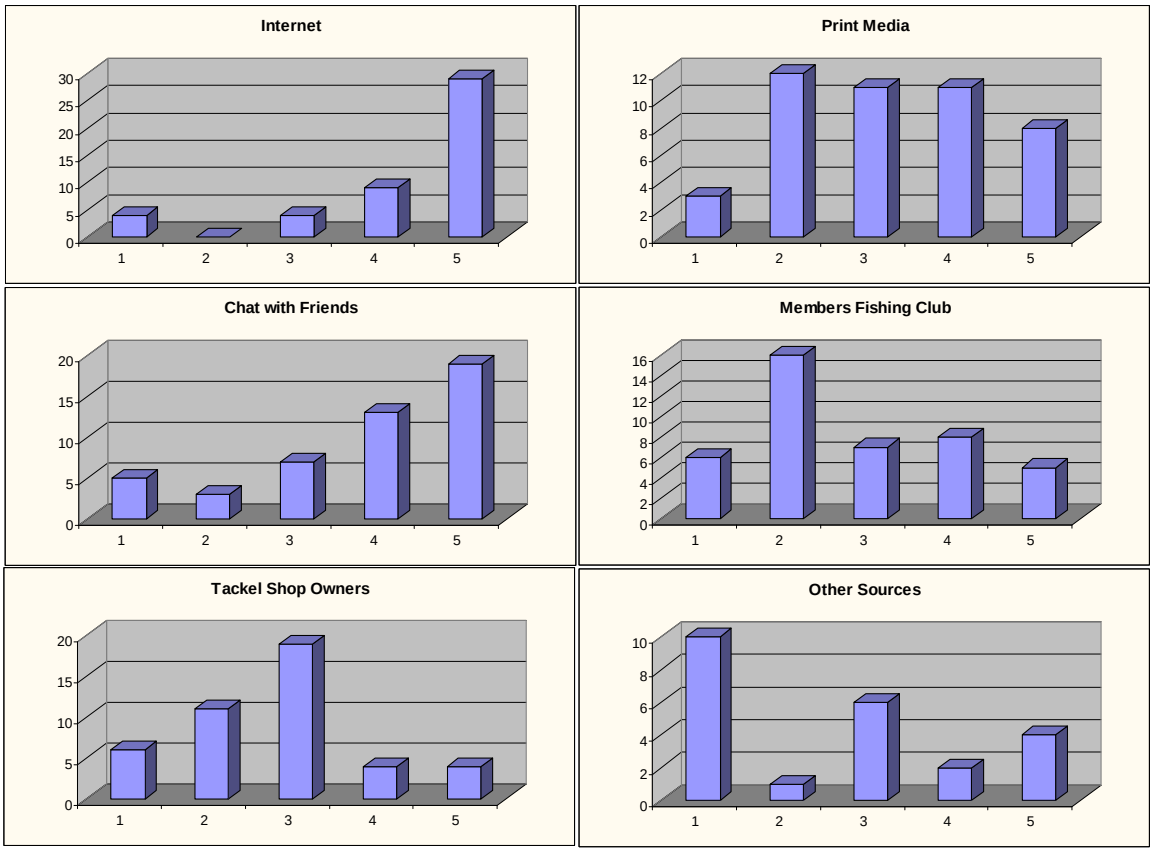

Figure 11: Question: What sources are you using if you would need information related to sport fishing? Please indicate significance in the ranking box (1-5, 1 not important, 5 very important)

The responses to this question clearly demonstrate that the Internet and its facilities (e.g. chat rooms in online angling communities) are the most important source for acquiring information about sport fishing. The result confirms that the member of angling communities was an appropriate target group for the PICOS concepts and applications.

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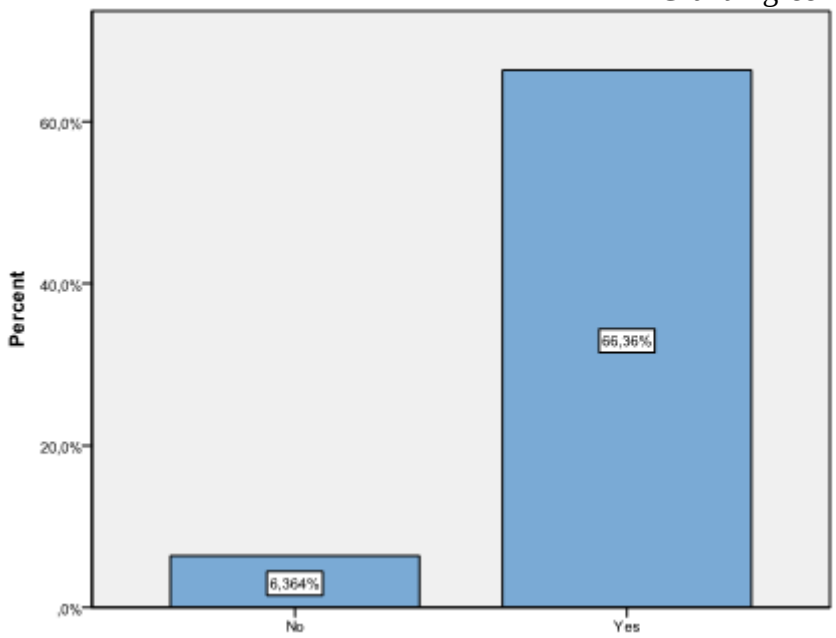

Figure 12: Are you an experienced user of the Internet and its resources?

This question relates to the previous one (what sources…) and demonstrates, that at least those angler who were interested to complete this questionnaire consider themselves as experienced user of the Internet (this was also an important criteria for the selection of the trial users for the lab and field tests and trials).

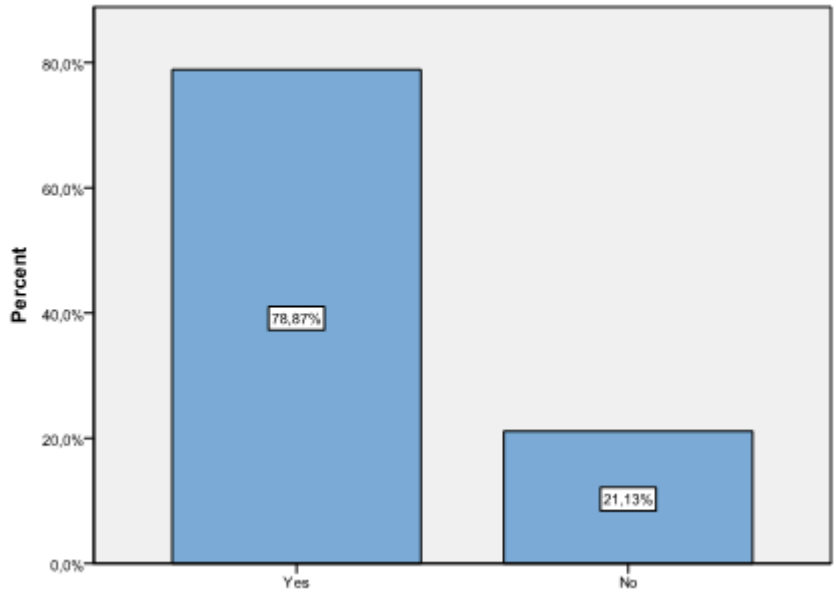

Figure 13: Are you aware of the various online services and online communities in the Internet for anglers, which provide useful information about your sport?

This last question relates to both previous questions, 12 and 13. Since the participants confirmed, that the Internet is a significant resource for information about angling and the majority also confirms that they are frequent users of the Internet, the responses here are consistent.

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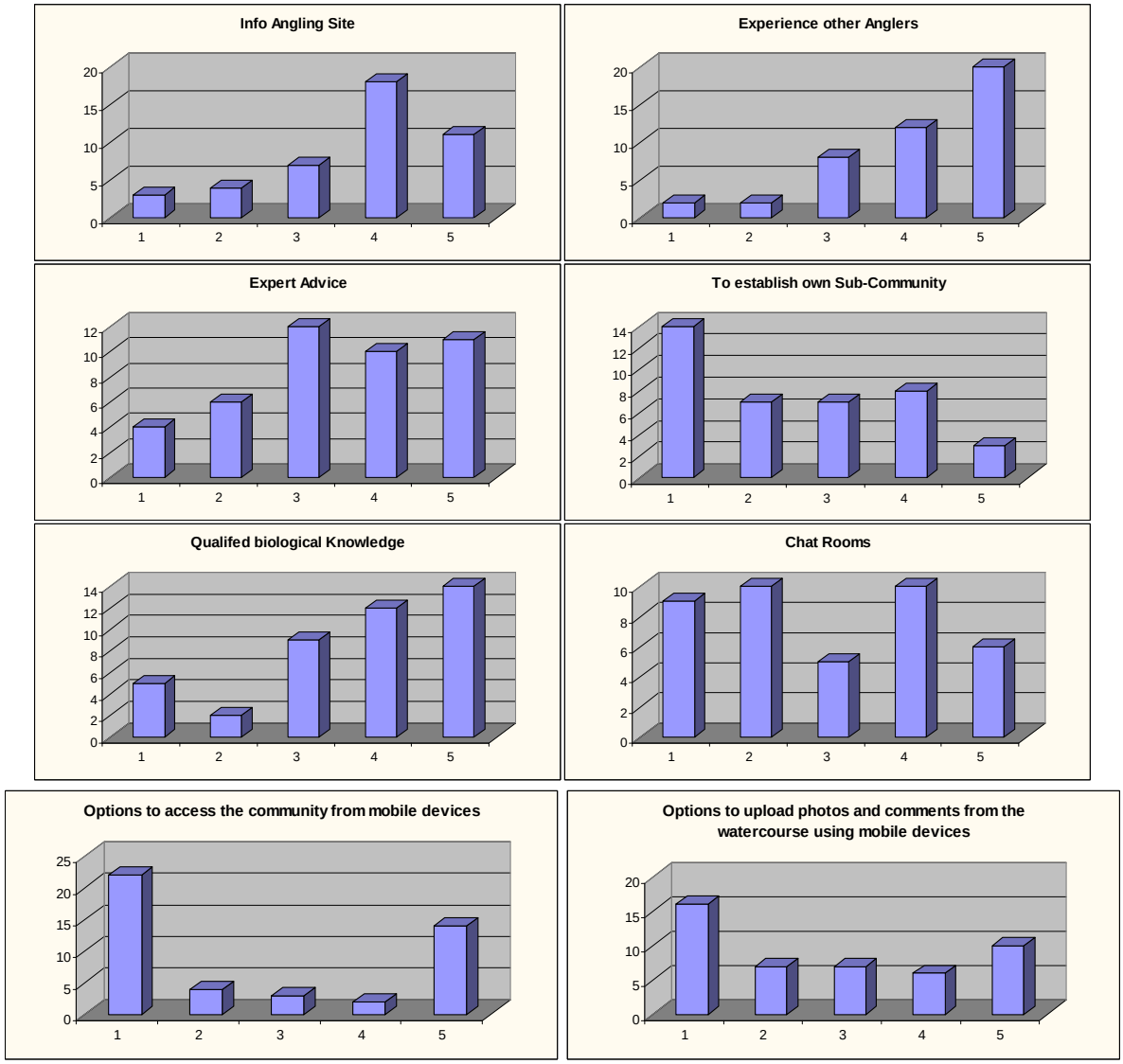

Figure 14: Question: What makes an angling community interesting for you? What are the interesting features (what would you like to find (1-5, 1 not important, 5 very important)?

The answers here are somewhat ambivalent. As expected, the acquisition ("download") of knowledge from other community members, from expert systems about fish and angling experience is appreciated from most of the participants. However, concerning the active participation ("upload"), specifically from mobile devices split the participants. Many of them want to use the mobile device for immediate communication with the community members (e.g. catch report and photo); but many others do not consider this feature as significant. It is assumed, that here experience is the major driver for the nature of the response; those who have already experience with uploading information from the mobile device are in favour of such options, and others who have not yet tried it, rather neglect it.

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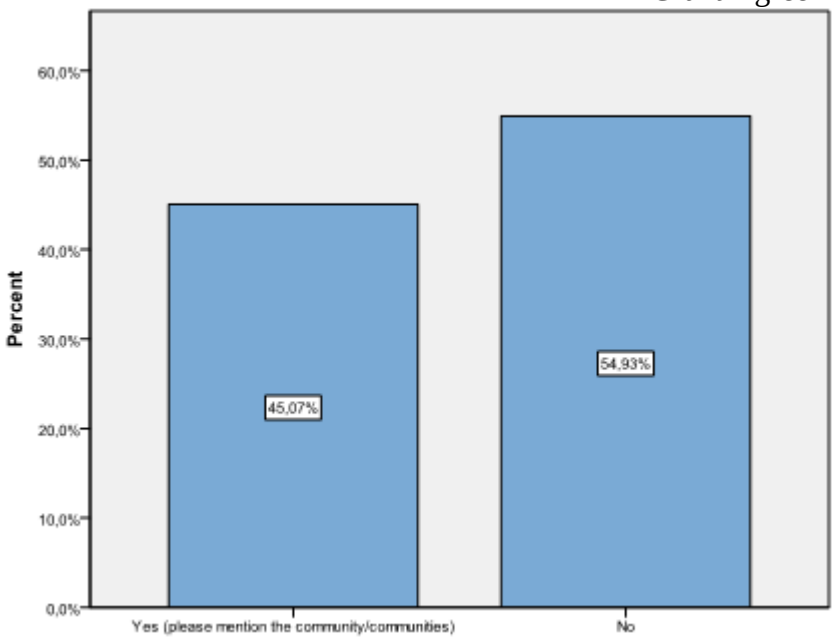

Figure 15: Are you a member of a virtual sportfishing community on the Internet?

It was important to know, to what extent Anglers are participating in virtual (online) angling communities. It was expected, that those who are a member of an online angling community would rather appreciate the PICOS mobile applications for angler and would like to try it.

Related Results from the User Trial:

A number of trial participants mentioned that they are registered members in online angling communities ("Anglerboard", "AngelnXXL", "Tightliners"[5], "Barsch-Alarm"[6], "Angler-Online"). Two participants (20%) already were member of an online angling community, which provides already mobile access ("iAngler").

These statements corresponds well with the result of the online questionnaire, where about 50 of the participants confirmed that they are participating in online angling communities.

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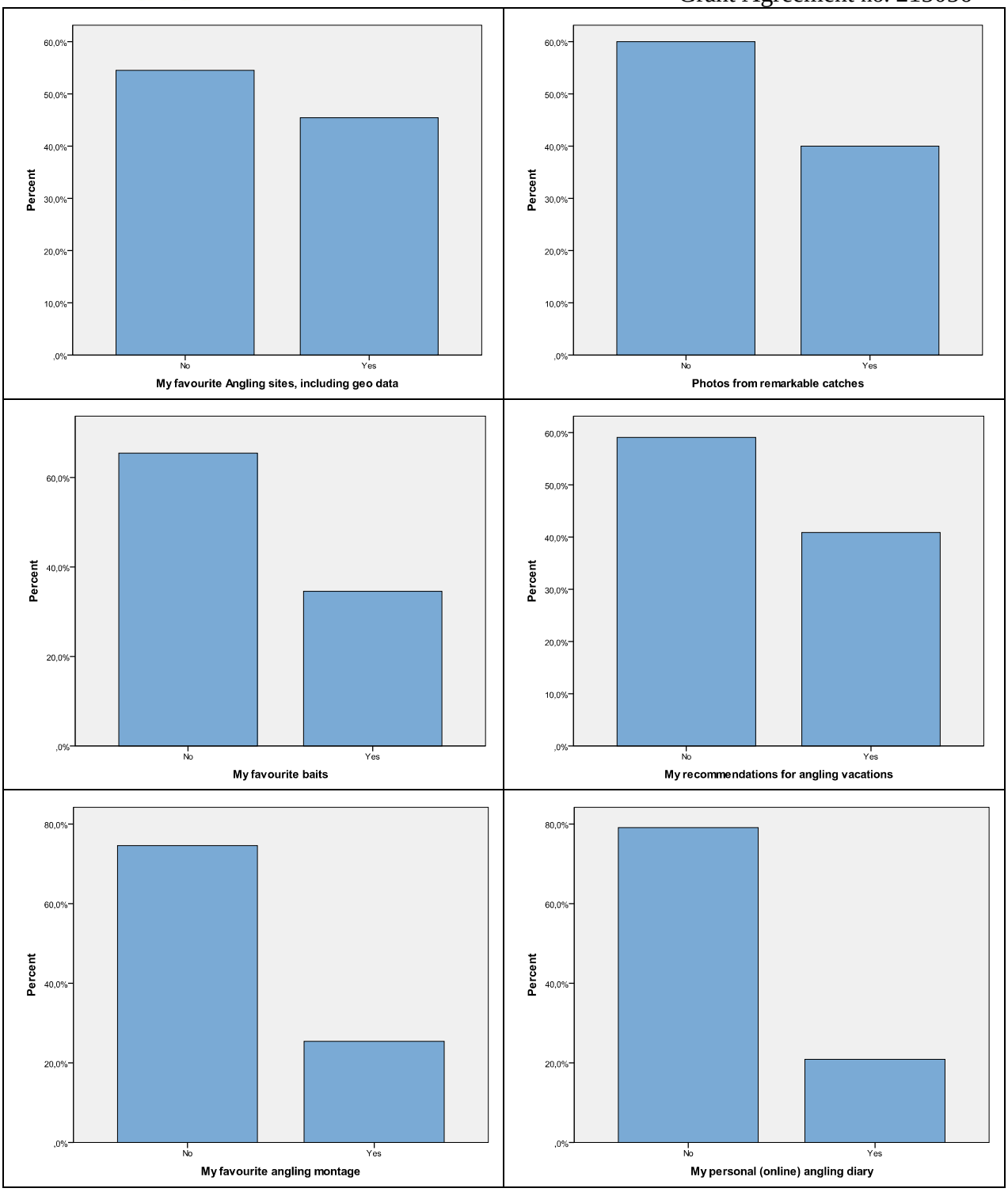

Figure 16: Question: Which kind of information about sport fishing would you like to share and with whom? Please indicate in the free text field with whom you would share the information (e.g. angling buddies, other anglers at the watercourse, loose friends, online community, buddies from your angling club etc....)

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This question was a very important acquisition of requirements for the design of improved trust measures of the PICOS angler application. In many cases, anglers want to share their information, but rather with known buddies from real world as well as known contacts in online communities. The evaluation of this kind of questions was a trigger for the compilation of the "private room" and "private sub-community" features in the PICOS Angler application.

Related Results from the User Trials:

The most used functionalities in the user trials were the Public- and Private Sub-Community, the Catch Diary, the Species Summary and the location based services (e.g. locate a buddy, watercourse advisor). Further the users reported that they liked the privacy enhancing features (Privacy Manager), especially the blurring of their own geographical location.

The trial users were in common with the opinion of the online participants: they are interested to have their private room within the community and just to share selected content with the other community members.

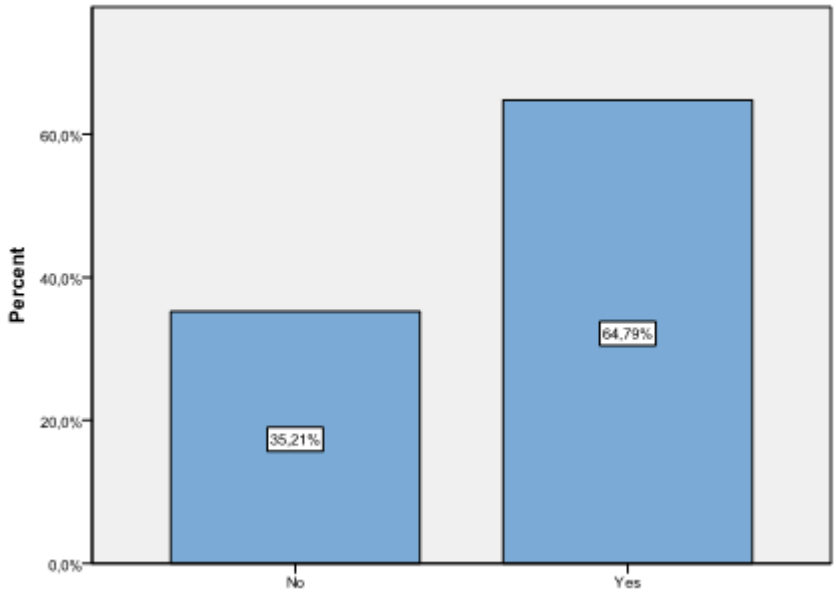

Figure 17: Have you heard about the global information system concerning fish, called 'Fish Base'?

This question was providing indications, if the trial community would appreciate a link to a global online information system on fish (FishBase) in order to verify a catch, to read about maximum size of a certain species, their feed, spawning seasons etc. Since the reaction was positive from the majority of the participants, a special version of FishBase was integrated into the PICOS angler application (and rated very positively in the user trials).

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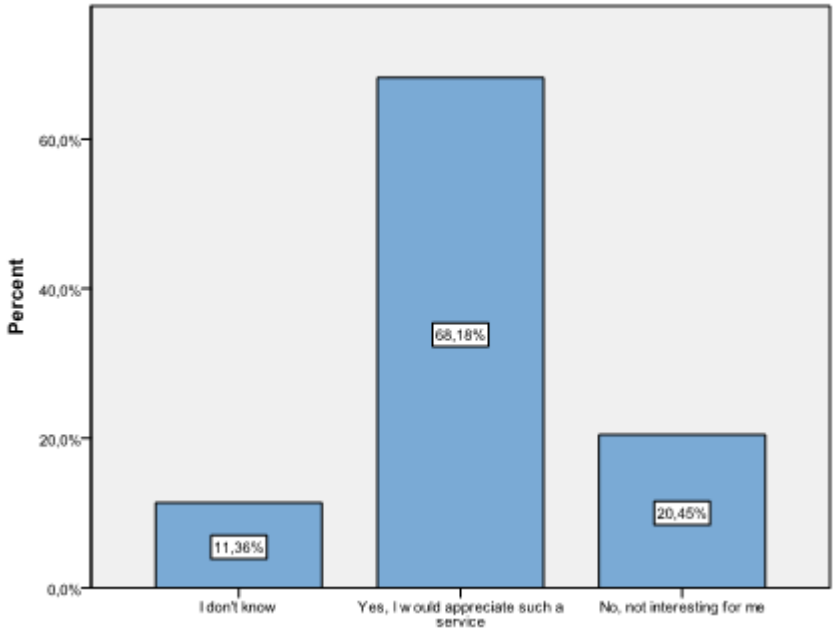

Figure 18: Question: Would you appreciate FishBase providing you with a new online service for anglers ("Angler's Diary") where you can establish a private Diary (up- and download personal information, catch statistics, photos, observations and much more) and where you can administrate your data from virtually any location with Internet access or via mobile devices?

This question was a follow up of the previous question. The majority was interested in such a service. Those who are probably familiar with the FishBase services, voted for such an option. In the PICOS application, generic features as described above were designed (the service was not offered from the FishBase facilities in the user trials).

Related Results from the User Trials:

In the user trials, the participants were asked if they would you use the PICOS angler application or several of its functionalities in the future. Most users answered that they would use several functionalities of the application, mainly the community functionalities and the catch report feature. Additionally the location based services and information on watercourses were of interest for the users.

Basically, the trial users were interested in similar features of an online angling community as compared to the participants in the online questionnaire (since there were no discrete features fixed for the PICOS application at the time when the online questionnaire was submitted, a straight comparison of features is not feasible here).

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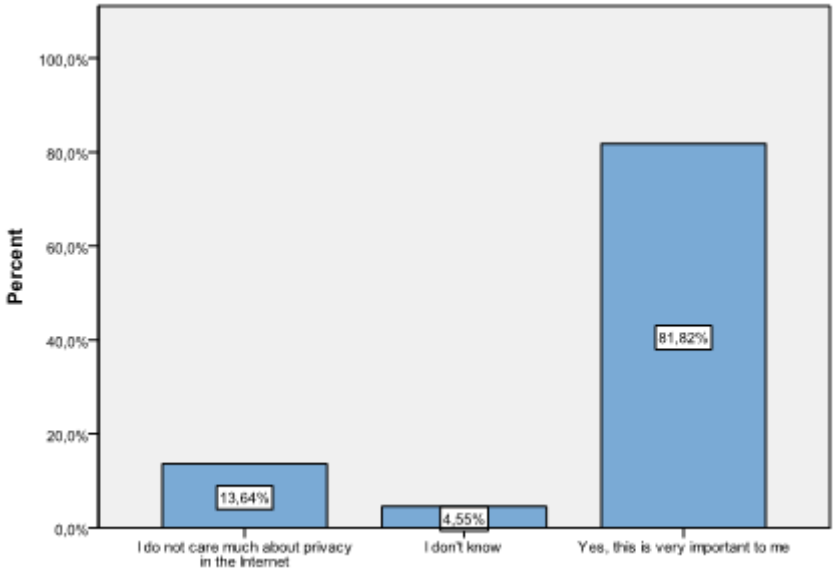

Figure 19: If you created an o online "Angler's Diary" in the FishBase environment, would you appreciate having full control of the personal information (i.e, who to allow access, encoding your personal data, spam protection etc.)?

The majority of participants have a profound interest to protect their personal information and related data. This result was considered with the implementation of the "privacy manger" functionality and the "private room" (my diary) facilities in the PICOS angler application.

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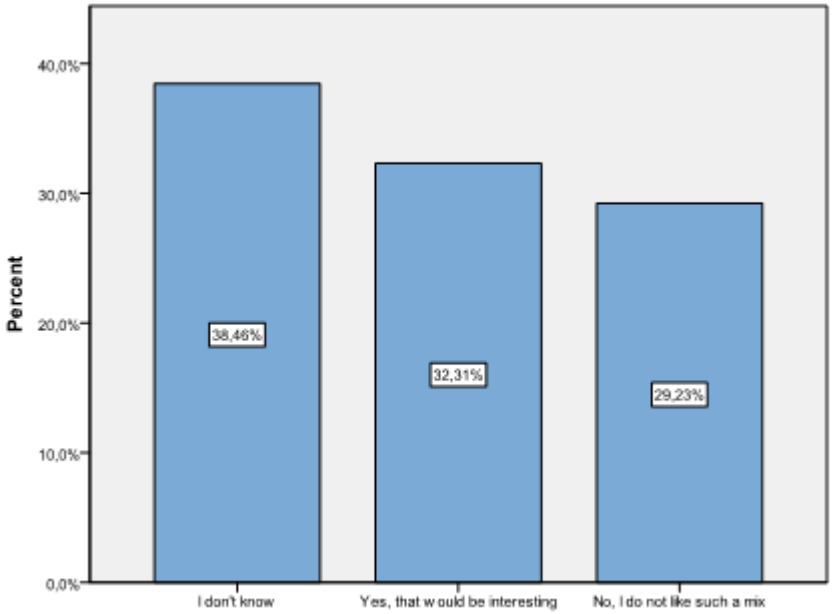

Figure 20: Would you be interested in an online angling community which combines your interests in angling with typical features of social networks?

The response to this question indicates, that anglers who were registered in an online angling community not necessarily wants to see the same set of features as compared to the usual online social communities. Anglers are apparently very much focused on their specific target, to catch more and bigger fish. Thus, the social features in the PICOS angler application were targeted to provide the maximum usage for angling.

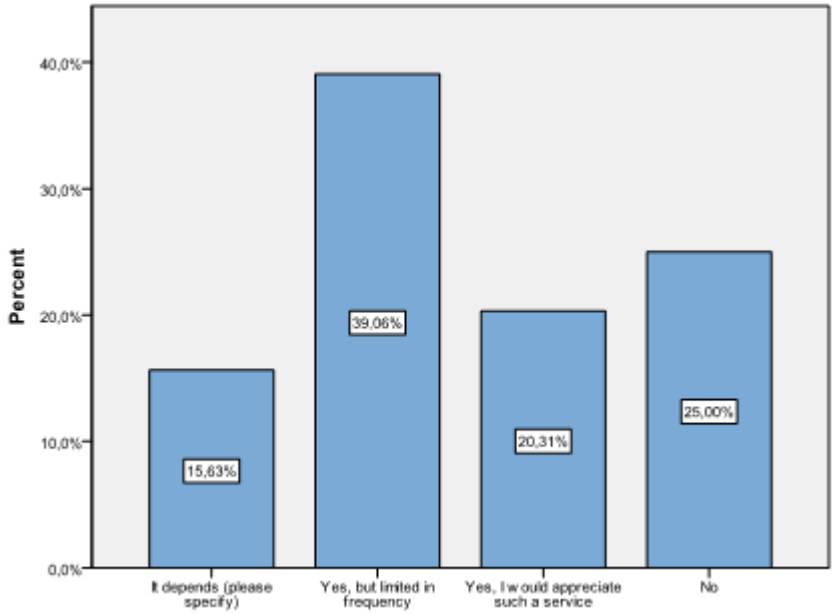

Figure 21: Would you be willing to receive angling advertisements which are customised to your personal needs and preferences?

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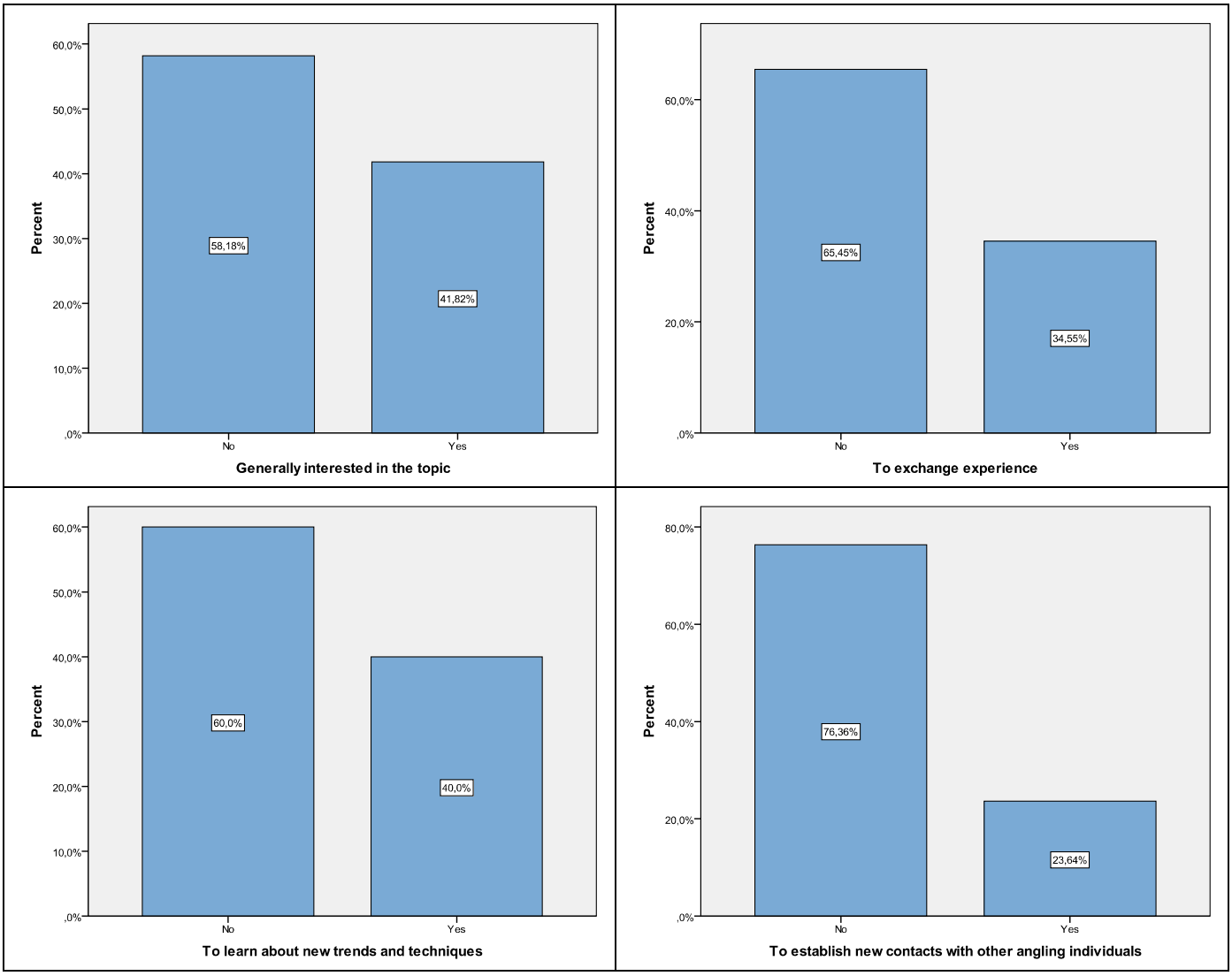
This question relates to a previous question above. In this case, just advertisement was mentioned as one source of information for angler in an angling community. Only a minority reject completely to receive information about e.g. trends and techniques from tackle shops. Most anglers are interested to be informed once new equipment is available. Thus, in the PICOS project, this approach was discussed as a feature for the trials (implementing tests on receiving advertisement from a certain tackle shop owner, including a score system, but neglected because of limited time resources.



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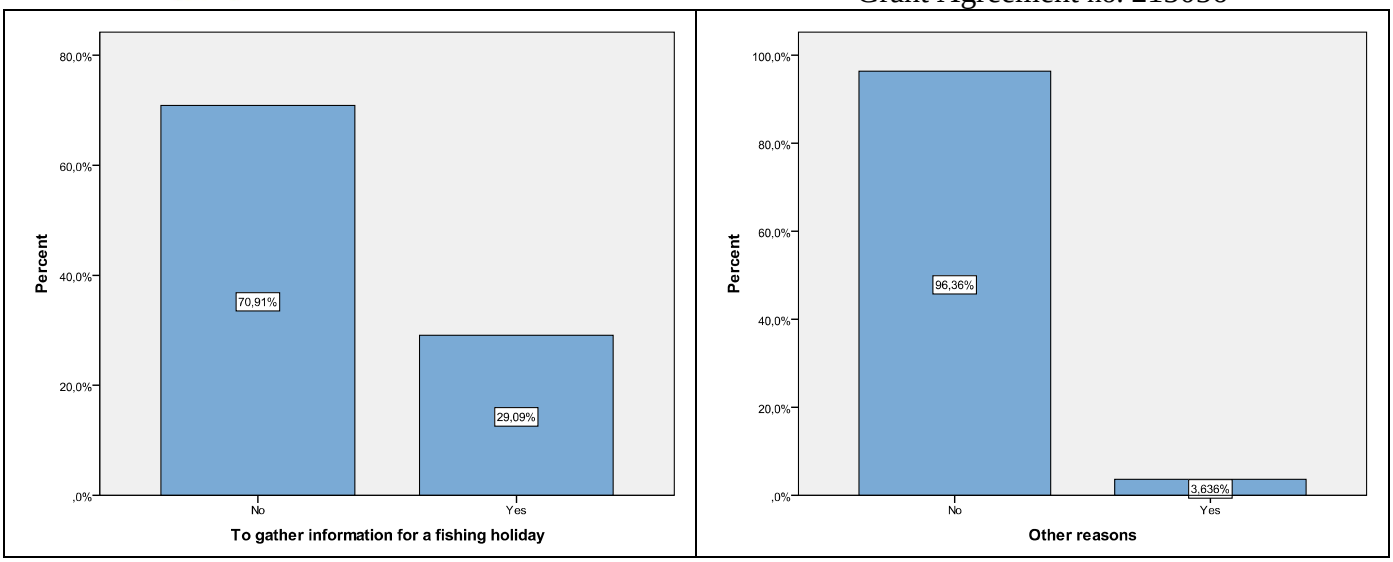

Figure 22: Question: What would be your main reasons to join an online angling community or network?

This question was targeting the reasons, why anglers would decide to join an online angling community. One of the stronger arguments was to learn about new trends and techniques, to exchange experience and general interest in this topic.

Figure 23: Question: When would you prefer to access your online angling community?

This question provided important information about the envisaged access to an online community. Although in the majority, angler apparently prefer to deal with their angling community before and after finishing fishing activities (most probably because of the more convenient access through laptop or desktop PC) there was a number of participants who would use the mobile version of their angling community while fishing (e.g. to upload catch reports and to inform buddies about their location). This

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result was providing a strong argument not just to deliver a mobile version of the PICOS application but also to provide access through a regular browser interface from the PC.

Related Results from the User Trials:

In the user trials, participants were asked in which context they guess they will use the PICOS applications. Most of them replied that they want to use it before, while angling and behind at home (using the web interface). Frequencies of the access to the PICOS application and the specific functionalities for each context situations are depicted in **Error! Reference source not found.** (example for the Vienna trial, similar in Kiel).

Item	Expectation	Behaviour
During Angling	4	4
Preparation of Angling	1	1
After Angling	3	5
On the way	3	4
At home	4	5
At the workplace	0	1
Leisure time	4	5

Table 2: Nominated situations in which the mobile application of the PICOS system was expected to and really used (multiple nominations were possible).

Most of the participants used the mobile application during angling, at home and during leisure time activities. In comparing expectations and behaviour, less people expected that they will use the device after angling compared to the frequency they actually used it beyond angling activities. In almost all cases people used the mobile application more often in the specific situations than they expected. Interacting with the mobile application, the most used functionalities were the passive functionalities (reading something). Contrarily the web interface was most of the time used to create a catch report and to add contacts.

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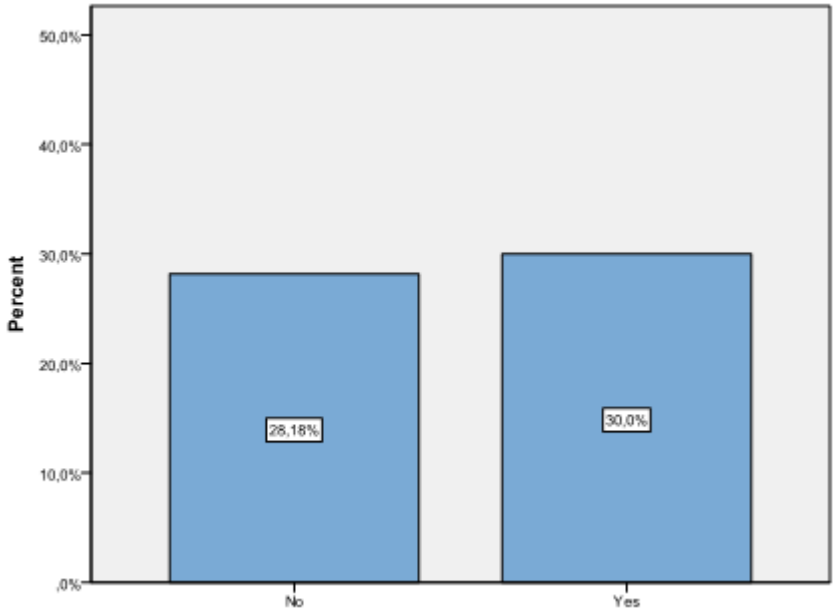

Figure 24: Are you a member of any online (social) network or community?

This question aimed to get information if the participants are rather experienced user of online (social) networks. It was expected, that experienced angler are rather more interested in new angling community concepts and applications.

Related Results from the User Trials:

About 70% of the user trial participants reported that they are a member of an online community and mentioned that they are using online communities on average 1-5 times per week. The majority of the participants are member of Facebook (41,67%), StudiVZ (33,33%) and MySpace (25, 00%).

This result demonstrates that significantly more trial users are member of social community compared to the participants of the online questionnaire. The reason may be that the age structure was somewhat different comparing both sources of information. The participants in the online questionnaire were more equally distributed over the age scale, i.e. there were younger participants in the user trials (its common that younger people tends to be more open to join social networks).

3. Privacy

In the “Privacy” section, in 14 questions the participants were asked to provide their opinion about the topic privacy, related to online media. Since one of the major goals of the PICOS project was to improve the privacy in online and mobile communities, the information which was gathered here was a firm ground to provide requirements to the architecture level of the PICOS angler application.

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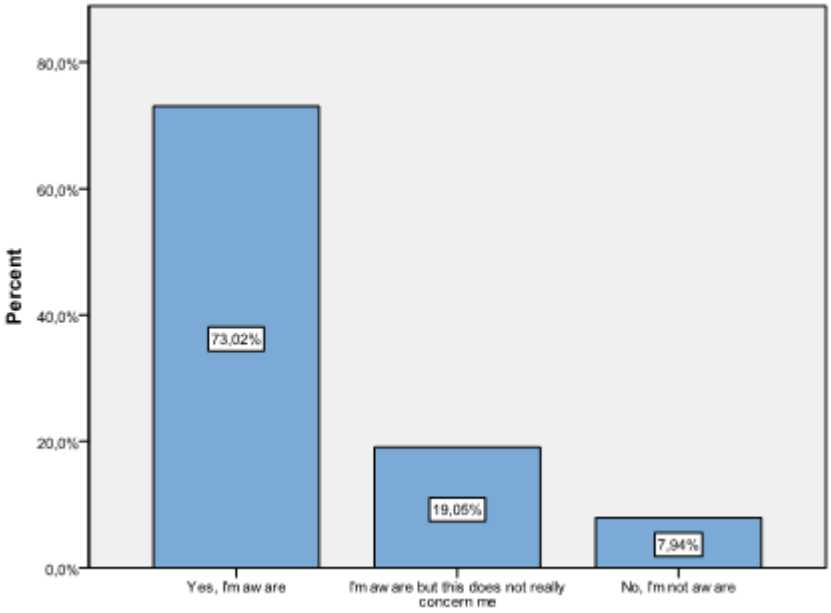

Figure 25: Are you aware by subscribing to an online angling community, you disclose a substantial amount of personal information?

This question was to achieve indications, if the participants are aware that they provide a substantial amount of personal data to the provider of the community in the registration process and related to their participation. Obviously the majority of the participants were aware that they disclose sensitive personal data in the process of participating. This result was important to consider raising awareness in the PICOS angler application whenever personal data are being disclosed to the community.

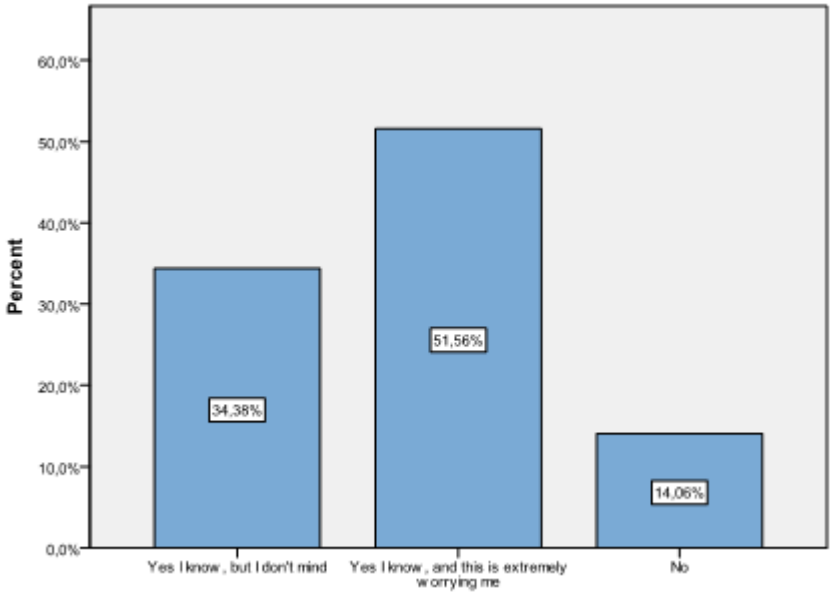

Figure 26: Are you aware that personal profiles in online communities and networks can be downloaded and saved by third parties, thereby potentially leading to the creation of a digital dossier of your activities in the internet?

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Many of the participants were aware, that personal data which are disclosed in various networks and online communities can be accumulated across the platforms and can result in a detailed personal dossier which can easily be misused. Thus, the majority replied, that they are very worried about this potential misuse of their data. For the PICOS project, these statements were an important starting point to develop the concepts for the angler prototype application.

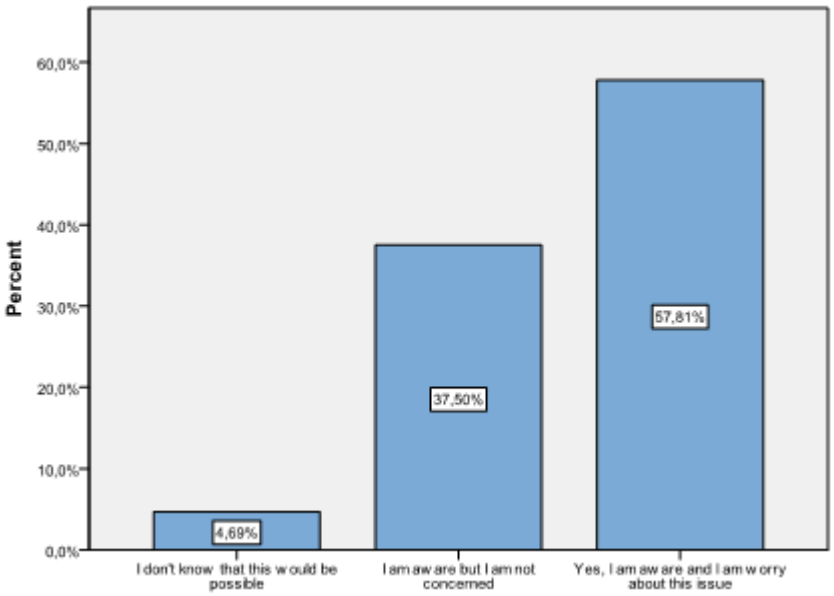

Figure 27: Are you aware that information, entered into Internet sites, can have high commercial values for third parties?

This question relates to the previous question about digital dossiers and continued to mention the nature of possible misuse of personal data accumulation and the commercial value of personal data. Again, the majority, at least those who are aware that such misuse is feasible, replied that they consider this fact as worrying.

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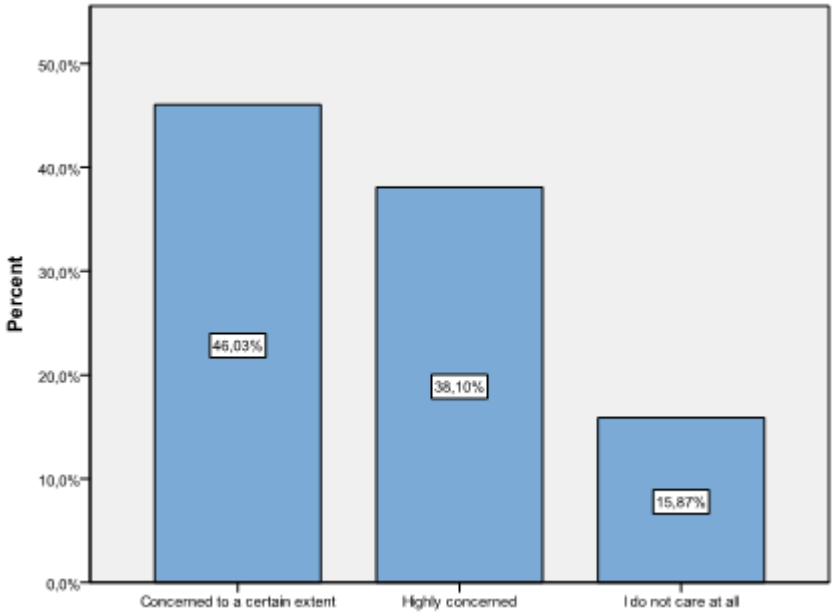

Figure 28: To what extent are you concerned that search engines might reveal parts of your private identity?

Most of the participants are concerned, that the present Internet search engines (e.g. Google) may be able to gather personal data of a person across the Internet and provide it to third parties without any kind of feedback mechanism with the owner of the data.

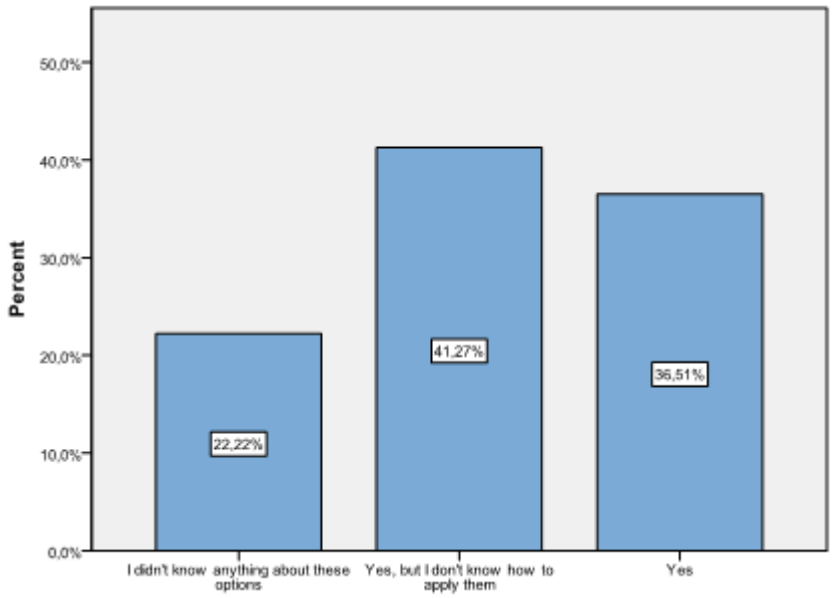

Figure 29: Are you aware that there are technologies that could help protect you from the risks which are addresses in the previous questions (unwanted use of your personal data in the Internet)?

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The majority of the participants are obviously interested to apply technologies which can help them to protect from the risks which were addressed in the previous questions, but only a minority knows about those kinds of options and how to use these means. It is obvious, that there is a lack of knowledge about protection measures and this was acknowledged in the user trials in the PICOS project.

Related Results from the User trials:

Most of the trial participants embraced the general concept of the angling application and the privacy functionalities of the PICOS angler application, but criticized the implementation, the feedback it provides and the design.

In general, the user obviously appreciated new approaches to enhance trust and privacy, however there can be a failure in applying such means because they are too complicates to use; this statements confirms the opinion of the online questionnaire participants, who knows about methods to improve protection of private data, but had no clue how to use it.

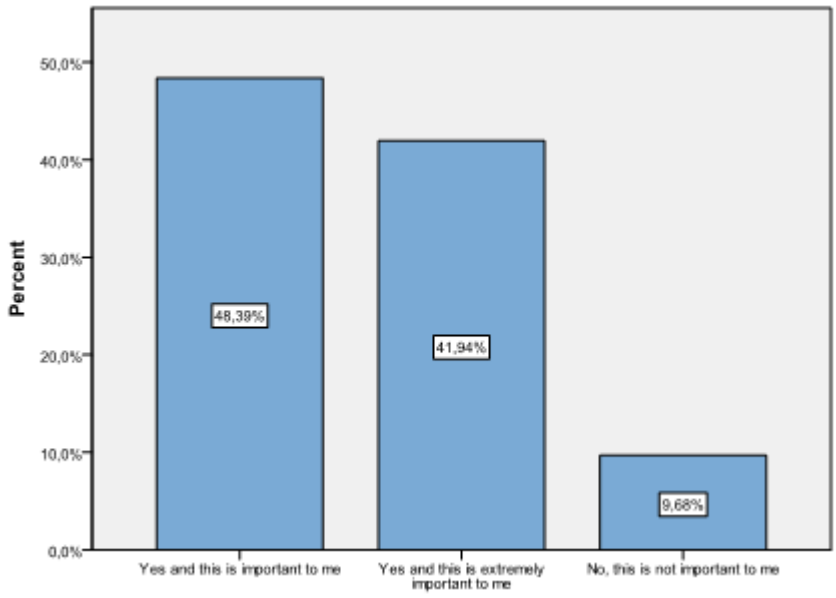

Figure 30: When cancelling your online community membership, would you require verifiable assurances that your personal profile and secondary information, public comments etc. will be erased completely?

For the majority of the participants it is important to be able to verify, that all personal data are deleted when cancelling a community membership. In PICOS, this kind of user requirement in an improved security of their personal data was considered as a revoking functionality which ensured that no traces of a person are left behind when cancelling the participation in the PICOS community.

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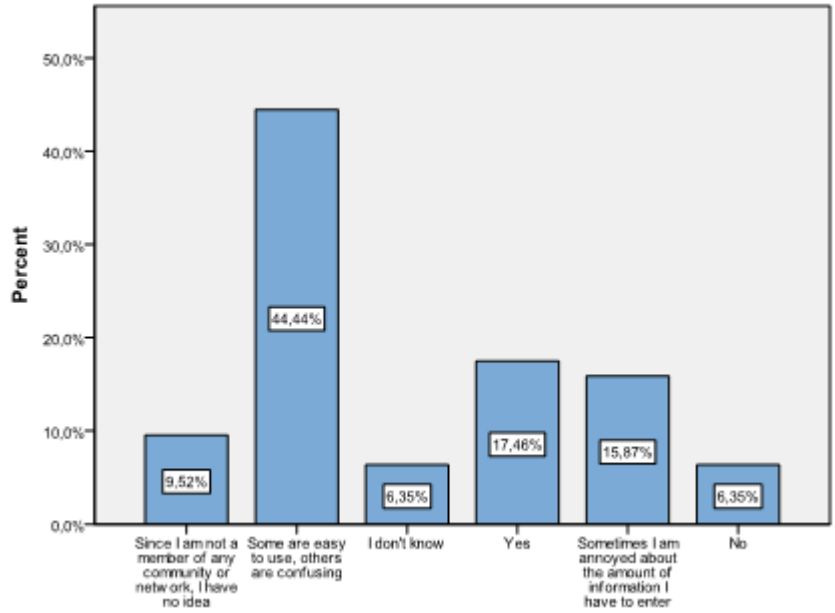

Figure 31: Would you say that interfaces of online networks and communities you interact with are easy to use?

There was no common sense in response to the question, if user interfaces in networks and online communities are easy to manage, specifically the privacy settings. Obviously, there is much desire to improve this part of online communities. PICOS tried to consider this concern in their applications.

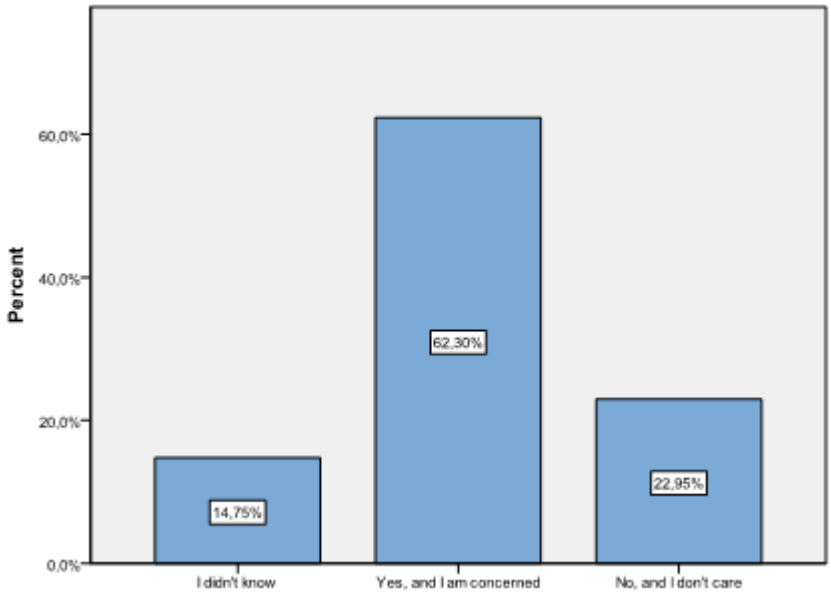

Figure 32: Are you worried by the fact that your personal profile may be stored and used in countries that have a different level of data protection than that of your own country?

The majority of the participants do not like the fact, that their data are stored in countries which have different level of data protection. Facebook was mentioned here as an example.

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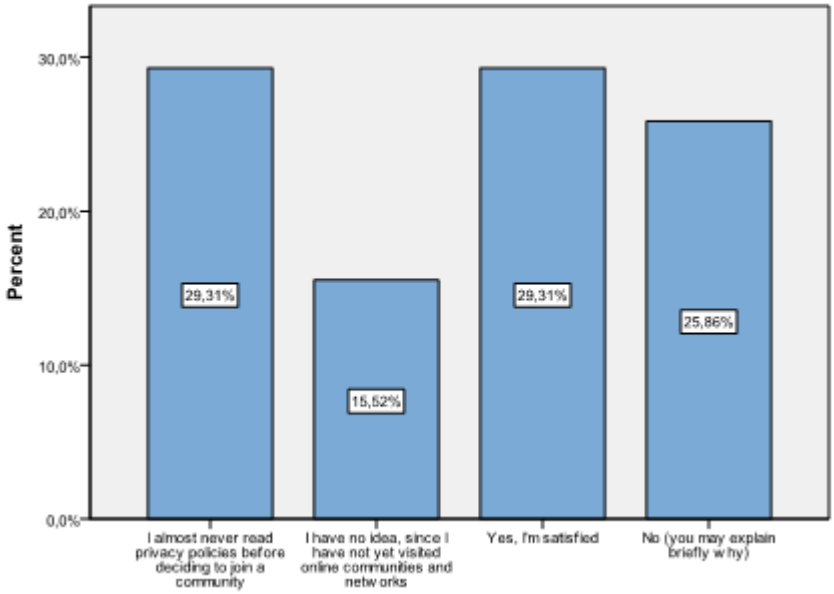

Figure 33: in your experience, are the online communities you visit transparent and clear enough with respect with respect to how they manage your personal information?

From the replies to this question it can be concluded, that the terms and conditions about the handling of privacy in online communities are not transparent, too much to read and not presented in a structure which is easy to understand for the majority of the user. In PICOS, simplification of such terms and policies was discussed related to the concept of the PICOS applications. There was a common sense that the aim must be to provide only short and concise terms and conditions which can be read and understand in a few minutes, otherwise no user would read it.

Related Results from the User Trials:

The trial users were asked, how they would rate the data protection and identity functions of the PICOS application. Most of the users appreciated the option to hide specific data in the personal profile on a detailed level. However, most users criticized that the means which helps to protect private data such as the policy creator is hard to discover and was very complicate to handle.

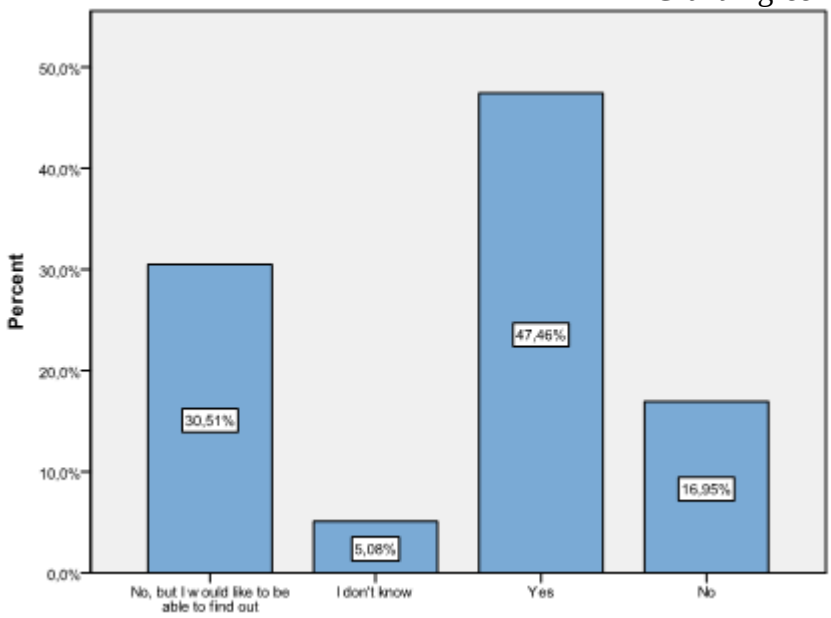

Figure 34: Would you suspect that email spam in your mail box could be obtained from a community you belong to?

Protection from unwanted advertisement and spam is a wish of most of the user of Internet applications. In this question the opinion of the user about the handling of their personal data in online communities was requested (e.g. e-mail addresses). It turns out, that the majority of the participants do not believe in the protection of their personal data in online communities (although it is often mentioned, that data are not provided to other Internet facilities).

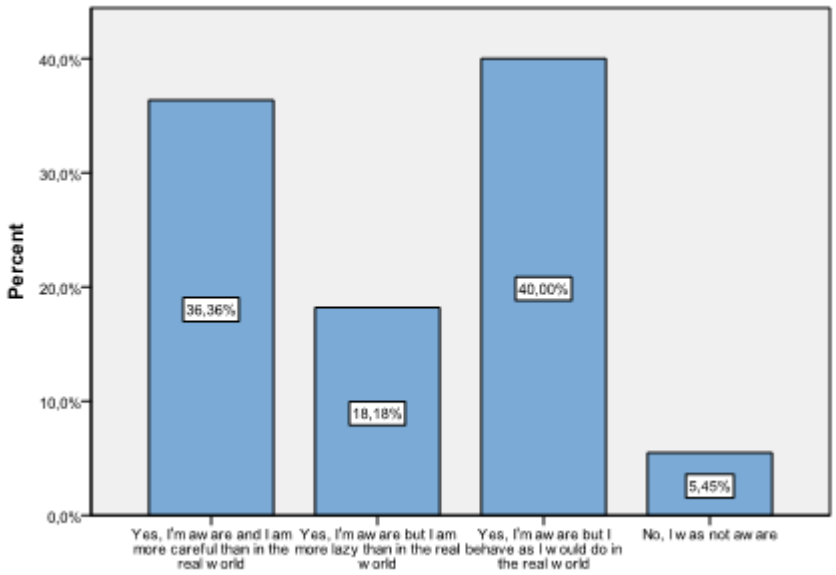

Figure 35: Are you aware of the possible size of an online community or, more specifically, the number and type of people who may access your personal information and does that affect your behaviour in relation to the online community/network?

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This question aimed to compare the behaviour of the participants in online communities and with their real world social contacts. Since many more individuals have access to personal data sets in Internet communities compared to the real world contacts, it was expected, that the participants are more careful in their online communities. However, there was only a minority, who supposes to be more careful when dealing with Internet facilities. Anonymity, as usual in online communities and networks, obviously decrease attention related to the submission of personal data compared to the real world.

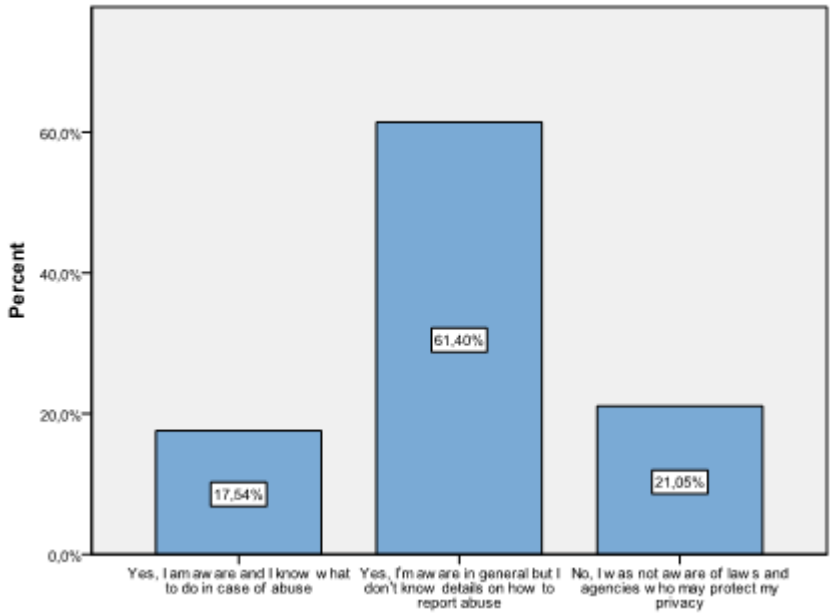

Figure 36: Are you aware of laws and agencies protecting your rights and do you know what to do in case of abuse?

This question connects to the question on the application of technologies which can help online user to protect from the risks of unwanted use of their personal data. The result here correlates to the responses on the previous question: only a minority knows about these agencies and how to use these means for personal protection. It is obvious, that there is a lack of knowledge about protection measures and although PICOS is not an "awareness project" these facts were acknowledged in the user trials in the PICOS project.

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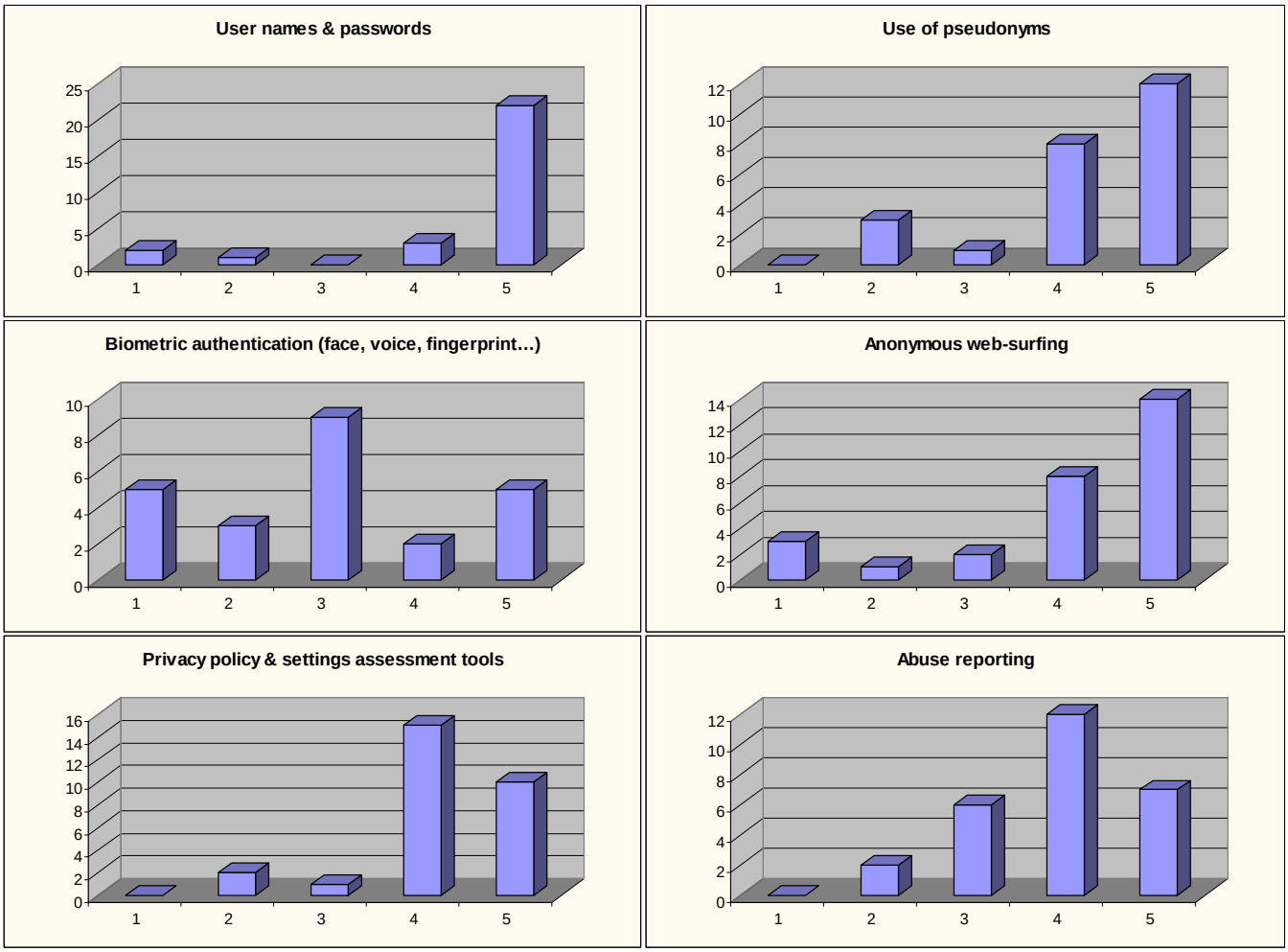

Figure 37: Question: Please rate (1-5, 1 not important, 5 very important) the following means for protecting your Privacy

The rating about the most interesting methods to protect privacy in the Internet is in common with the presently most used measures: user name & password, pseudonyms and anonymous websurfing. The PICOS project considered these ratings in their architecture of the applications, although new approaches such as biometric authentication were discussed.

Trust

In the "Trust" section, 7 questions tried to verify the users view about trust in the Internet in general and specifically in online communities. The findings on the trust section had a significant impact on the design of the PICOS trial angler applications.

The following question required written comments from the user, which are cited below without any editing.

Question: *What makes you trust people in online communities (i.e. personal interaction in the real world, repeated communication over time, assessment of behaviour over time, a rating system as applied e.g. in e-Bay)? Please explain briefly.*

The following comments are selected as the most representative about this question:

(1) Personal interaction, continuous exchange online, a rating system and reputation of members;

(2) Maybe e-bay type to a certain extent, if not trust is always a risk;

(3) Trusting to people in online communities is similar to how I trust people in the real world. Sometimes it is better to communicate online, because it is written;

(4) Over time, if you used the same site over again and you see the same folks posting you can weed out the folks who make sense and those who are just blowing smoke;

(5) Repeated communication and personal interaction;

(6) I don't trust anything that goes thru computers;

(7) Rating system of community members;

(8) All of the above. There are some people I have met and fished with after meeting them online and it has worked out well. There are others that I wouldn't dream of ever meeting in real life;

(9) Trust the communities i visit because I know the people behind them;

(10) Repeated communication over time;

(11) Personal interaction in the real world;

(12) A combination of all mentioned mechanisms but maybe prior knowledge is the most important and then communication and assessment of behavior in the virtual world over time;

(13) People I know from the real world;

(14) A rating system as applied e.g. in e-Bay;

(15) Good reputation about the info people provide and their behavior;

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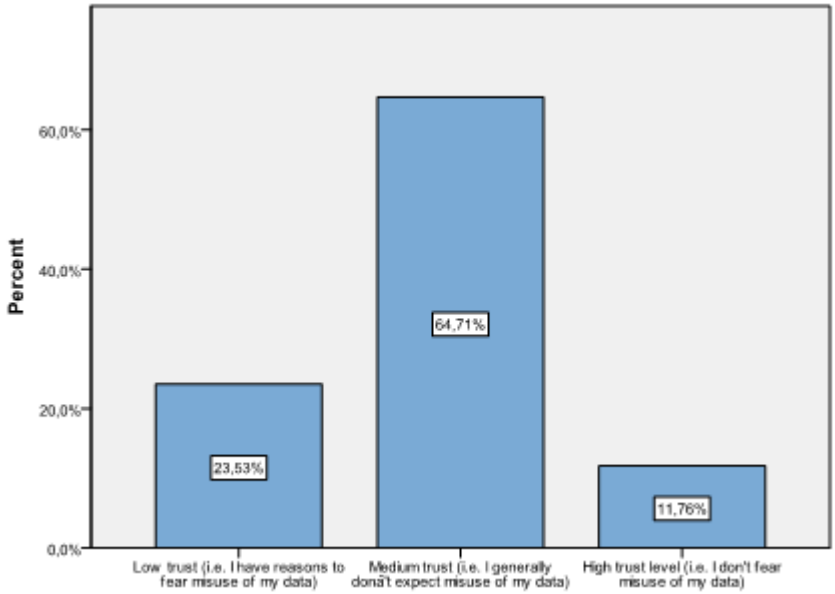

Figure 38: To what extent do (would) you trust angling community members or angling community organisers?

This question is asking for an essential condition in (online) communities: to what extent user trust into other members of the community and in the community owner. The responses indicate in the majority a medium to a low trust level, i.e. the user do not expect in general an intention of other community member and community owner to misuse their personal data, but they do not overlook the possibility that personal information can be misused.

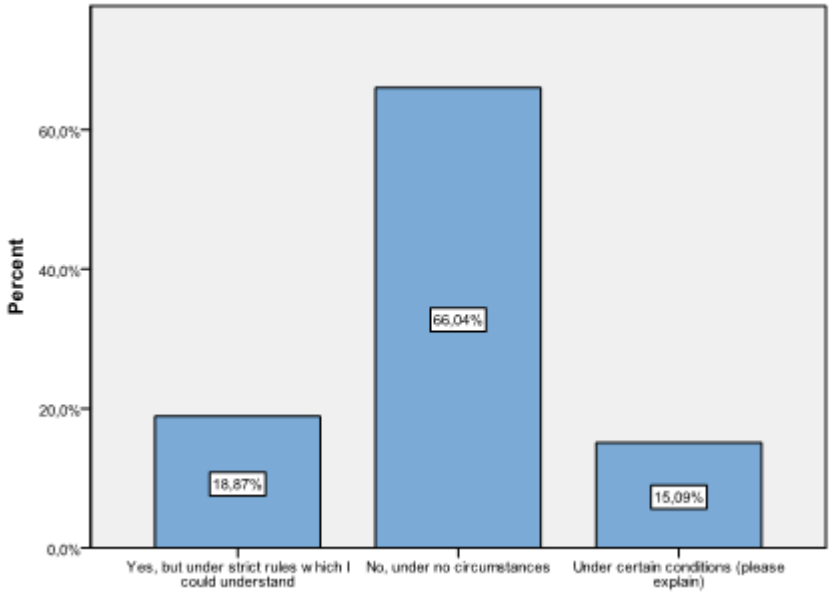

Figure 39: Would you be willing to provide private information to third parties who are not community members and community providers?

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The previous question dealt with the trust level inside of a community and among their members; this question continues with the opinion about personal data which are used outside their own community. The majority strictly rejects, that their personal data and private information are being used outside of the dedicated community. The PICOS project has acknowledged these results and provided means in the angler application which allows the user to have the full control over their personal information ("privacy settings", "private room") and the option to post information only to closed private sub-communities where only invited member have access.

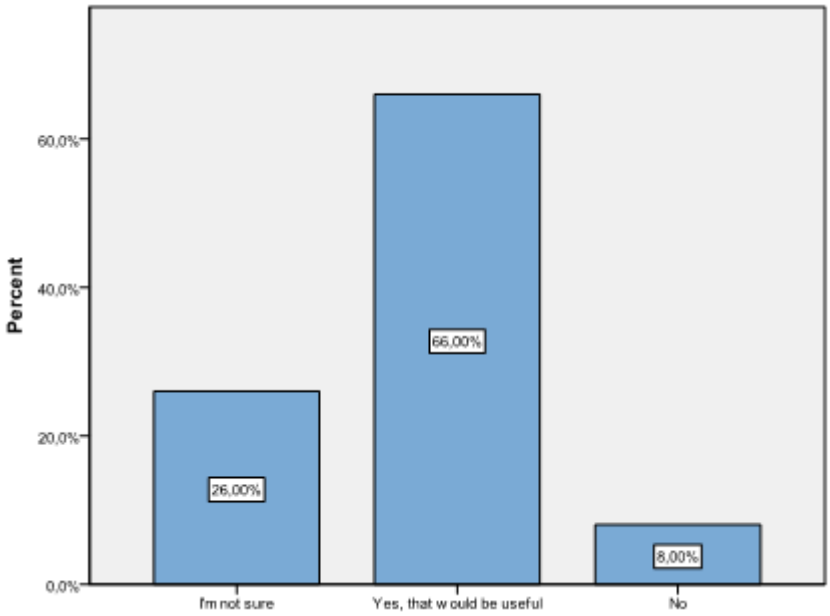

Figure 40: Would you appreciate an indicator, built into your web browser that gives you confidence in the site?

Most participants would appreciate an indicator in their browser which indicates confidence into the site. The background for this question was to acquire information if Internet users care about privacy and trust. It was obvious, that such an indicator would enhance the trust level for Internet user.

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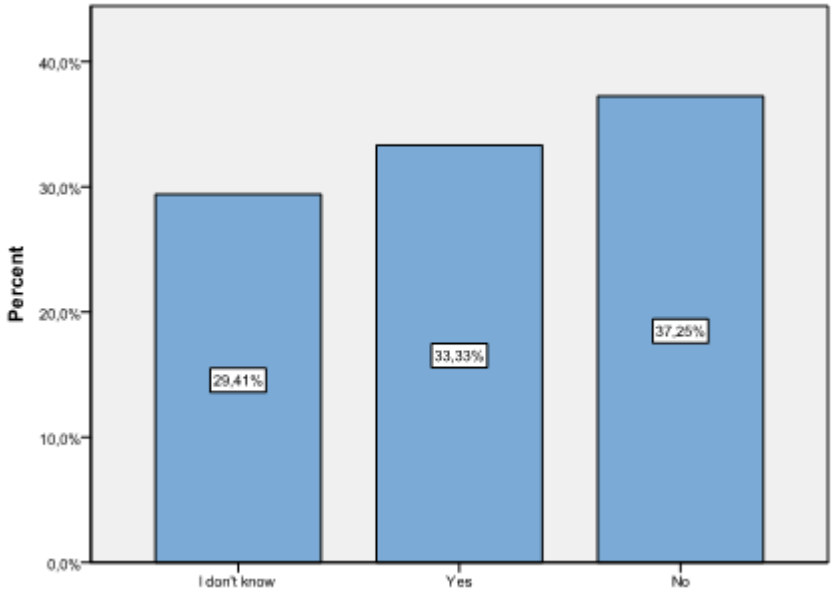

Figure 41: Do you mind disclosing of personal data to the community?

The question if online community member care about if their personal data including their site activity are being disclosed to other community members was answered equally with “yes” and “no”, with some participants in between. In general, the type of response to this question is supposed to depend very much from the type of the community, if members are familiar with each other, if the user is a frequent visitor of the site etc.

Related Results from the User trials:

The trial users were asked how they would evaluate the data protection and identity functions of the PICOS application which relates to the question above in the online questionnaire.

The majority of the users evaluated the data protection functionalities as very useful and positive. It was obliviously for the users that the developers pay attention on these concerns.

This is a clear statement of the majority of the trial participants, that enhanced privacy and data protection is appreciated in online communities, which is somewhat different from the results of the online questionnaire.

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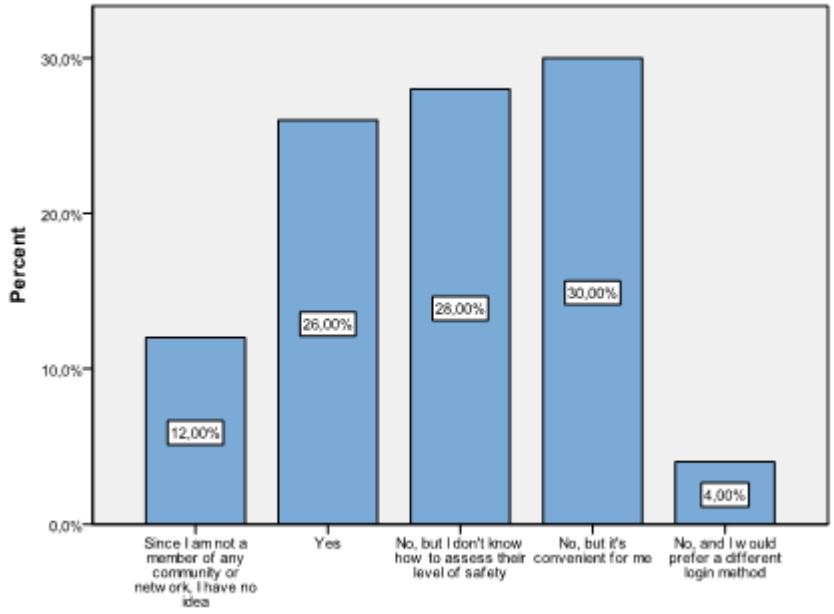

Figure 42: Do you think that access-control and authentication to online communities is safe/strong enough?

The presently used access controls to online communities are mostly user name and password. The majority of the participants in this questionnaire do not consider this means as really safe, but obviously they are prepared to accept it since it is a convenient approach. This result indicates, that even more save access controls still need to be convenient to use and should not take more time as the present means.

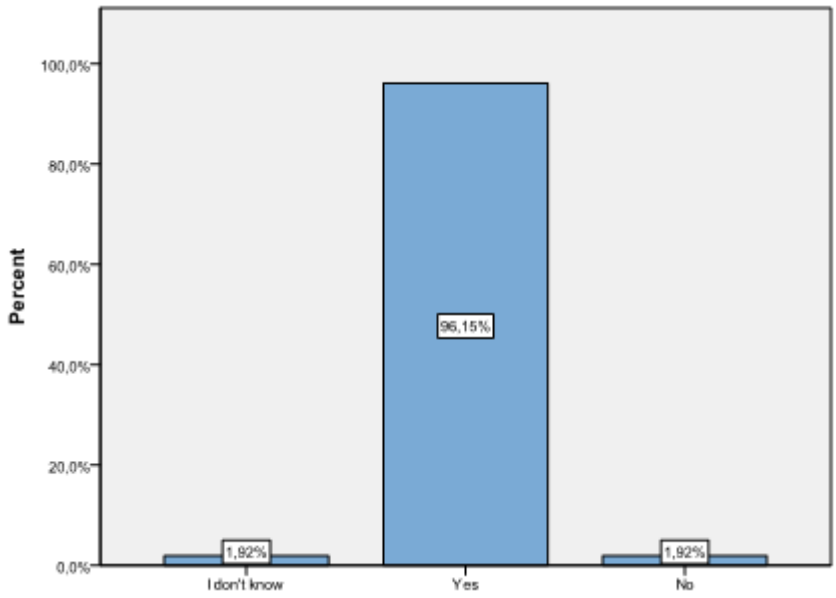

Figure 43: Would you appreciate to the warned automatically when your personal data are shared or distributed in a context which is not in accordance with your interests?

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There is a clear voting from the participants that they want to be warned, if their personal data are shared in other resources without any kind of agreement of the user. In the PICOS project, this was acknowledged with the "privacy manager", which allows a fine granular permission setting and with the "privacy advisor", which warns the user if he is going to share sensitive personal data with other members of the community. This concept may help to care about the users concern, as expressed in the response to the above question, that no unwanted data submission will take place in the online world.

Related Results from the User Trials:

The trial participants appreciated the Privacy Manager and the option of the fine granular settings and the Privacy Advisor which warns the user when sensitive personal data are about to disclose to other community members which corresponds to the desire of the majority of the participants of the online questionnaire; more than 95% of participants want to be warned when their private data are distributed in a context they do not like.

Mobility

The questionnaire provided 4 questions which should indicate the requirements of online community members who want to access their facility from mobile devices. The results of this section were important for the type of device which was supposed to be used in the user trials and in general to what extent applications will work on the type of devices most of the user prefers in their communication.

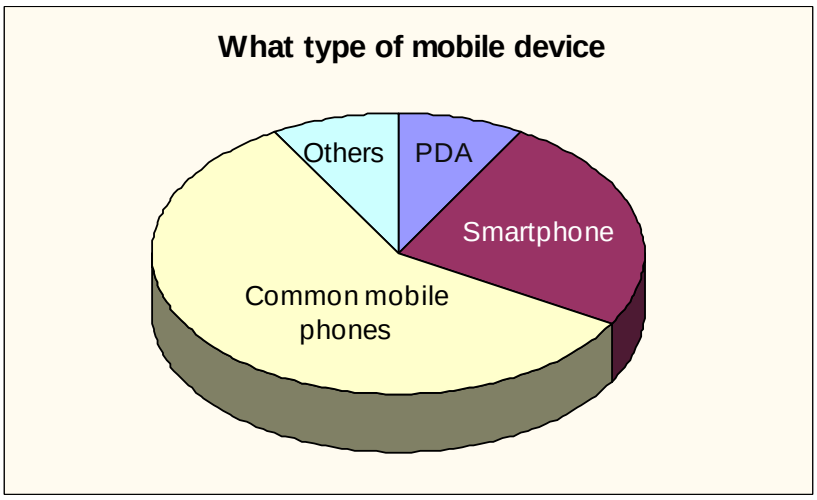

Figure 44: Question: What type of mobile device would you like to use for services while being mobile?

The majority of the participants in the online questionnaire were obviously still using common mobile phones which provide only limited options for a mobile access of online communities. However, since the market of mobile devices quickly evolves and the turnover rate of mobile phones is very short, it is probable that many more users will switch to more sophisticated devices pretty soon (in 2010, about 7 millions of Smartphones were sold in Germany, about 10 million are expected for 2011). In the PICOS user trials, an up-to-date Smartphone was provided (NOKIA 5800) which allowed to take advantage

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from more sophisticated applications to access and to communicate online and mobile (e.g. location based services).

Related Results from the User Trials:

All participants were owners of a mobile phone. The majority of the participants use their mobile phone for "calls" (100,00 %), "SMS/MMS" (100,00 %) and the "calendar" (75%). Only few are using their device for web surfing and e-mailing.

The question how they like the text entry in the mobile device and how much text you would write they answered from "as less as possible" to "SMS length", indicating, that only with more sophisticated Smartphone devices apparently more functions will be used in the mobile context.

The assumption is in accordance with the online questionnaire participants, where most of the participants still own a common mobile device, where no sophisticated features can be used while being mobile.

The following question required written comments; a representative selection of answers is presented below.

Question: *Which functions of mobile devices would be attractive for you in the context of mobile?*

1) Communities (e.g. GPS-like features, including geo-tagging (latitude, longitude), navigation, bluetooth, WLAN-Access, location based services etc.);
2) gps + LL, Bluetooth;
3) GPS, Camera, UMTS, WLAN-access;
4) I would need to think of specific examples of usage of these features and know the cost to assess if they would be interesting for me and in what contexts;
5) GPS-like features, including geo-tagging (latitude, longitude), navigation;
6) Where I am is irrelevant to the community, except for where I live for commenting on local issues;
7) Navigational mapping
8) GPS, WLAN, UMTS, camera, navigation software, internet access

From this list, it can be concluded, that most participants would like to switch as soon as possible to a Smartphone, in order to be able to use all those features mentioned here (GPS including , WLAN access, Bluetooth).

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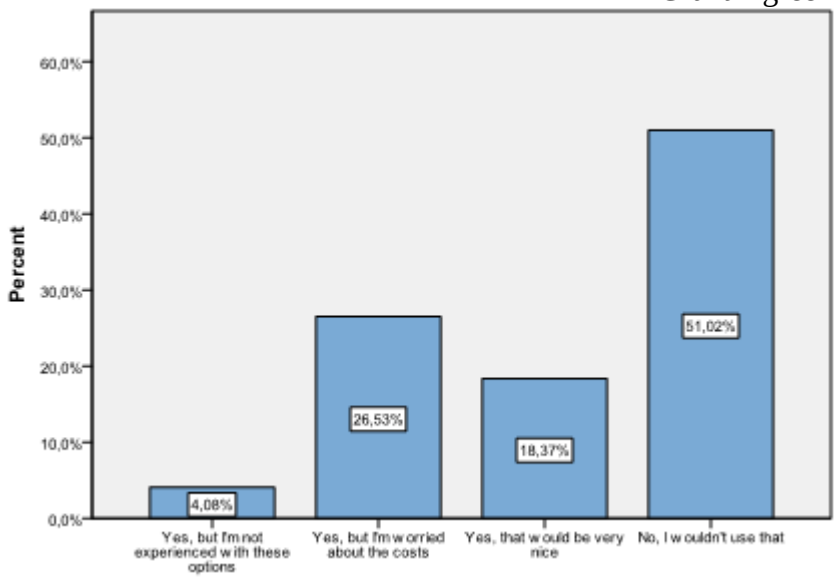

Figure 45: Assumed your mobile phone would support this option, would you like to send photos and information about a big catch straight from the watercourse to your own online database, including the option to deliver an automatic alert to a selected group of buddies?

This question aimed to acquire information, if community member would use certain feature of their Smartphone to access and to communicate with their community while being mobile. This information was specifically interesting in relation to the feature design of the PICOS angling applications, since angler have to be per se to be mobile to be able to practice their hobby.

Related Results from the User Trials:

The trial participants mentioned, that they would use the mobile features while fishing to a limited extent; features specifically where more text is needed, or photo processing, would be rather accomplished from the PC at home. In summary, receiving messages and photos is welcome with the mobile device, but submitting messages is limited as mentioned in the comments above (send text only with typical SMS size).

There is obviously still a technical obstacle, while using mobile devices and the options to post more than simple text messages (which is common, as concluded from the questionnaires and user statements). Thus, it can be expected, that with increasing distribution of smart phones, the usage of more sophisticated features will certainly increase. E.g. a comfortable “speech to text” feature may change the user behaviour while being mobile.

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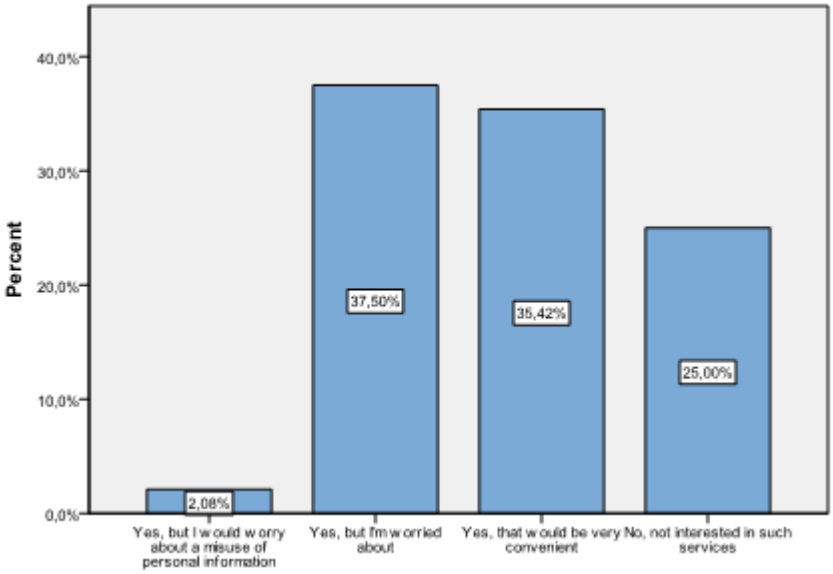

Figure 46: While travelling, you discover an interesting fishing site. Would you then be interested in related online services via your mobile device such as information on licensing, next tackle shop, next accommodation and restaurants?

This question aimed to acquire information how useful angler would consider location based services which requires a Smartphone. The majority rated angling related location based services as interesting and useful features of a community application (angler are very pragmatic in their leisure time activities), however there is some concern about the fate of the personal data which needs to be broadcasted in the context of location based services (e.g. my current position, thus the "Blurring" functionality was introduced to the application). The PICOS project acknowledged the results from this question and provided related location based services which were much appreciated in the user trials (e.g. "locate your buddy on a map", "find/provide a fishing site/fishing spot").

Related Results from the User Trials:

The trial participants were asked which functionalities of the PICOS applications they appreciated the most in the mobile context. Among those features which were the used are the location based services, the species summary followed by the watercourse advisor. The blurring option was hardly been used in that context; apparently the user were familiar with each other (already friends or becoming familiar in the user trials) and most of them did not see the need to hide their position.

Summarising

Two questions tried to summarize the consequences for the user behaviour of all those issues raised in the previous questions about identity management, trust and privacy and the other question tried to verify, if the participants had experience with ICT in general.

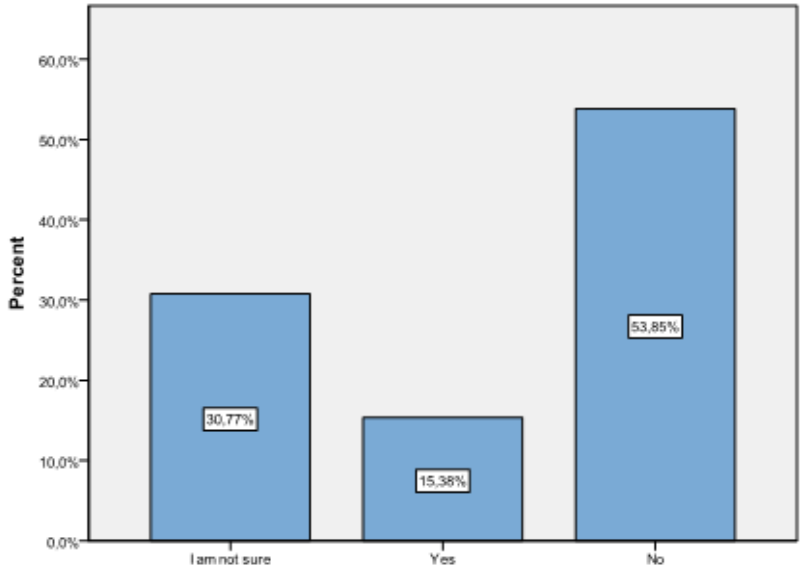

Figure 47: Taking into account all the issues raised in the previous questions, will you consider changing your behaviour in relation to online communities or networks?

In summary, only a minority of participants considered to change their behaviour when dealing with online networks and online communities. This was a bit surprising, since in a number of the previous questions about trust and privacy, many participants were concerned by the rather poor private data protection in present online communities. It is assumed, that the user stick to their behaviour because it is more convenient not to change the behaviour and procedures (e.g. when visiting an online community). Nevertheless, the PICOS partner are convinced, that many user will apply better protection means when they become available, when they are easy to use and would not take more time.

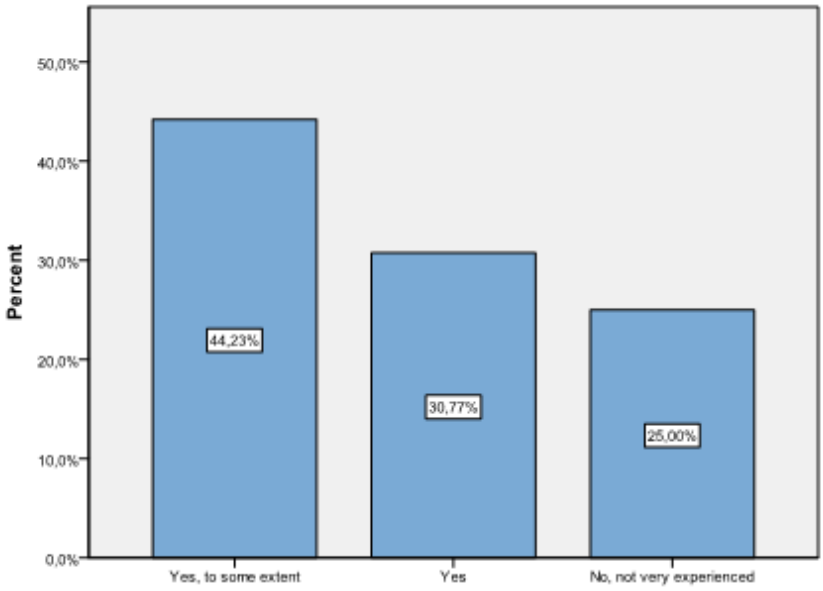

Figure 48: Would you rate yourself as an experienced user of the most up-to-date Internet techniques and the options which are provided with modern mobile devices?

The PICOS project receives research funding from the Community's Seventh Framework Programme.

This question aimed to confirm that the majority of participants in this questionnaire are experienced user of ICT. This is an important prerequisite to be sure that the responses provided in this questionnaire were significant for the selection and compilation of the features for the PICOS angler applications.

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